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## MEMORANDUM

**TO:** Physics Department Graduate Students and Faculty

**FROM:** Sean Gavin, Graduate Advisor                      Ext. 7-0156, Room 320

**SUBJECT:** 2020-21 General Information Handout for Physics Graduate Students

**DATE:** August 24, 2020

This is an information handout for graduate students. Please read this document carefully! In addition, the Office of International Students and Scholars on campus distributes important information to international graduate students.

The following physics courses can be taken for graduate credit in the upcoming academic year, 2020-21:

Fall Semester 2020*	Winter Semester 2021*
PHY 5010 Astrophysics and Stellar Astronomy	AST 5100 Galaxies and the Universe
PHY 5100 Methods of Theoretical Physics I	PHY 5340 Optics
PHY 5200 Classical Mechanics I	PHY 5341 Optics Lab
PHY 5620 Electronics & Electrical Measurements	
PHY 5750 Biological Physics	
PHY 6480 Quantum Computing	PHY 6400 Quantum Physics I
PHY 6500 Thermodynamics & Statistical Phys	PHY 6450 Material & Device Char.
PHY 6600 Electromagnetic Fields I	PHY 6780 Research in Biomedical Physics
PHY 6750 Applied Computational Methods	PHY 6850 Modern Physics Laboratory
PHY 6991 Research Survey (section 001)	PHY 6860 Computational Physics
PHY 6991 Data Analysis I (section 002)	PHY 6991 Data Analysis II
PHY 6992 Teaching Assistant Training	
PHY 7070 Survey of Nuclear Physics	PHY 7050 Survey of Condensed Matter Physics
PHY 7110 Methods of Theoretical Physics II	PHY 7410 Quantum Mechanics II
PHY 7400 Quantum Mechanics I	PHY 7560 Advanced Condensed Matter Physics
PHY 7500 Statistical Mechanics	PHY 8810 Advanced Particle Physics
PHY 8850 Quantum Field Theory I	PHY 8860 Quantum Field Theory II
PHY 8991 Special Topics Seminar <sup>Δ</sup>	PHY 8991 Special Topics Seminar <sup>Δ</sup>
PHY 8995 Colloquium	PHY 8995 Colloquium

\* See the University Graduate Bulletin for course descriptions. For more details, consult with the Graduate Advisor.

<sup>Δ</sup>PHY 8991 will have 1-credit seminars on Nuclear/Astro/Particle Physics (section 001) and on Atomic/Bio/Condensed Matter (ABC) Physics (section 002) in Fall 2020 and Winter 2021.

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## **GENERAL INFORMATION FOR GRADUATE STUDENTS IN PHYSICS**

While graduate students are still responsible for all rules contained in the Graduate Division and the College of Liberal Arts and Sciences sections of the Wayne State University Catalog, the Graduate Committee has attempted to gather together all relevant rules for physics graduate students in this document.

### **How Many Credits to Take Each Semester (Maxima and Minima)**

A Graduate Assistant or a student on a Fellowship is expected to register for at least 10 credit hours each semester but not more than 12 credit hours (fellowship tuition waivers cover up to 12 credit hours). *(It is to be noted that, at present, Graduate Assistant tuition waivers cover only up to 10 credits, and the tuition for any credits taken in excess of this amount must be paid by the student.)* In general, Fellowship students are expected to take a larger academic load and progress at a faster pace than Graduate Assistants. The absolute upper limit on the number of credits is sixteen per semester, but students who are working full time at an outside job must get permission from the Graduate Advisor to take more than eight credits. *Note: While 6 hours is defined as the minimum load for a graduate assistant, a full time student is defined as one who is taking a minimum of 8 graduate credit hours.*

### **Information for Supported Ph.D. Applicants**

#### **1. Approval of Course Selection**

Prior to registration, the Graduate Advisor/Research Advisor must approve all courses. Non-Physics courses may be taken only if the student is making satisfactory progress, as defined by the Research Advisor and Graduate Advisor. As a rule, non-physics course registration will seldom be approved for students who have not successfully completed the department's Ph.D. qualifying exam. *Note: The approval of courses is required for all supported Ph.D. students at every stage of their program.*

#### **2. Drops and Adds**

All course drops and adds must be approved by the Graduate Advisor. A University Drop/Add Form needs to be signed by both the Department Chair and the student's Research Advisor (if one can be identified). If a course is dropped without departmental approval, then the graduate student will be responsible for tuition for that dropped course. *Note: The approval of drops and adds is required for all supported Ph.D. students at every stage of their program*

#### **3. Course Registration Requirements and PLAN OF WORK**

Students must confer with the Graduate Advisor upon starting graduate work to make a PLAN OF WORK that sets up the most expeditious route to achieving their goals. The PLAN OF WORK must be submitted to the Graduate School before the student can take the qualifying exam.

The Department of Physics and Astronomy will henceforth establish the following minimum registration requirements:

First Year: Four 7000 level courses or two 7000 level plus four approved lower level courses

Second Year: Four 7000 level courses or three 7000 level plus two approved lower level courses

The list of all 7000 level courses is provided on page 9. The spirit of this minimum registration requirement policy aims to insure the most expeditious progress of each student through the degree program and to define the minimum level of annual progress expected by the department. Students who fail in their first attempt at the qualifying exams should consult with the Graduate Advisor regarding possible changes in course selection that would help them in their second try.

For more details of the course requirements for the Ph.D. degree (including after the qualifying exam), see page 10.

On the PLAN OF WORK, grades for courses already taken are entered, including Master's degree credits. C grades may appear on the PLAN OF WORK if A grades are present to offset these grades, i.e., the grade point average of the courses listed must be at least 3.0. Credits that are more than ten years old, if not part of a Master's degree, cannot be included. In addition, the PLAN OF WORK must contain a list of the planned courses so that the total credits of 90 hours distributed as noted on page 10 appears. If at a later time, the student wishes to change his/her PLAN OF WORK, for example, by taking a different course, he/she must obtain permission of his/her dissertation advisor and the Departmental Graduate Advisor and file the required form with the Graduate School. Note that transferred credits from another institution earned for a Master's degree must have a grade of A or B to appear on the PLAN OF WORK; B- is not acceptable.

#### **4. Annual Review**

An annual review of the performance of supported students will be made during the winter semester each year. The review will be based on information provided by the students themselves on a form provided for this purpose and on information provided by the student's research advisor and/or the Graduate Advisor. This review is intended to identify those students who are not making reasonable and timely progress toward their degree objectives. Such students are generally not candidates for continued financial support. *Note: The annual review is required for all supported Ph.D. students at every stage of their program.*

### **Information for Master's Degree Applicants**

#### **1. Eligibility for Teaching Assistantships**

The department does not extend financial support in the form of teaching assistantships to Master's degree applicants. The financial support, in the form of GTA, is reserved only for Ph.D. applicants.

## 2. Approval of Course Selection

The Graduate Advisor or the Research Advisor prior to registration must approve all courses. Non-Physics courses may be taken only if the student is making satisfactory progress, as defined by his/her Research Advisor and the Graduate Advisor, toward his/her graduate degree.

## 3. Drops and Adds

All course drops and adds must be approved by the Graduate Advisor. A University Drop/Add Form needs to be signed by both the Department Chair and the student's Research Advisor (if one can be identified).

## 4. Course Registration Requirements and PLAN OF WORK

Students must confer with the Graduate Advisor upon starting graduate work to make a PLAN OF WORK that sets up the most expeditious route to achieving their goals. During this first academic year, and to the extent allowed by department course scheduling policy, all Master's degree students are expected to register in each of the fall and winter semesters for three departmental courses. The spirit of this policy is to insure the most expeditious progress of each student through the departmental course requirements and to define the minimum level of annual progress expected by the department. For more details on course requirements for the Master's degree see page 15.

## 5. Annual Review

An annual review of the performance of Master's degree students will be made during the winter semester each year. The review will be based on information provided by the students themselves on a form provided for this purpose and on information provided by the student's research advisor and/or the Graduate Advisor. This review is intended to identify those students who are not making reasonable and timely progress toward their degree objectives. *Note: The annual review is required for all Master's degree students at every stage of their program.*

### Repeating a Course

A graduate student may petition to repeat a graduate course in which a grade of C or lower is received. Only two such courses may be repeated during the student's graduate studies at Wayne State. Permission to repeat a course must be obtained from the Graduate Office of the College of Liberal Arts and Sciences (for Master's students), 2155 Old Main, or the Departmental Graduate Committee (for Ph.D. students) before registration for said course takes place. The original grade of the course will remain on the transcript, but only the grade received in repetition of the course will be used in computation of the student's grade point average for the degree program. Students will not receive university financial aid for repetition of courses.

### Research and Dissertation Courses

Registration for these courses requires prior approval of the Graduate Advisor at every stage of a student's program. This holds true for unsupported as well as supported students.

#### **PHY 9991 to PHY 9994 - Doctoral Dissertation**

30 Credit Hours

See page 10 for details.

**PHY 8999 - Master's Thesis**

8 Credit Hours  
See page 16 for details.

**PHY 7999 - Master's Essay**

3 Credit Hours  
See page 16 for details.

**PHY 7996 - Research in Physics.**

This course is primarily for students who are beginning their research. A maximum of 12 credit hours is allowed.

**PHY 7990 - Directed Study**

This course is intended to cover specific material that is not covered in regular courses and which has a well-defined scope and conclusion. A maximum of 6 credits are allowed. Prior consent of instructor and Graduate Advisor is required; application forms are available from the website of the Graduate School.

**Registration for Dissertation, Thesis or Essay Beyond the Required Credits**

It should be noted that a graduate student who has enrolled for all elections (including essay, thesis, or dissertation) stipulated by his/her PLAN OF WORK, and who has completed all the requirements of these elections, except for those associated with either the essay, thesis, or dissertation (whichever is appropriate), will be required to register for at least one credit of essay, thesis, or dissertation direction during each semester that he/she uses facilities or receives advisory services until such time as the student:

- (a) completes the requirements for the degree;
- (b) declares himself/herself no longer a candidate for the degree, or
- (c) exceeds the time limit allotted for securing the degree.

For those credits, the student will pay customary fees and will register as an auditor. No degree credit will be granted for these elections that are beyond the required three credits for an essay, eight credits for a thesis, or thirty credits for a dissertation. A mark of Z (Auditor) will be recorded on the student's record for additional elections. Also, the student should be aware that the graduate school will not grant assistantships to students who have completed all the requirements for the Ph.D., including the 30 hours of dissertation credit. Thus, in planning a program, a student should arrange the spacing and timing of courses so that the 30 dissertation credits will not be completed until the dissertation is actually finished.

**Information Concerning When Physics Classes are Offered**

This handout includes information on the anticipated scheduling of physics courses that are open to graduate students in subsequent academic years. Courses at the 5000 level or above are only offered during specific semesters. The construction of a PLAN OF WORK must take into account the timing of the prerequisites for each course. The general list of the scheduling of courses is given on page 9. Please consult the list so that you can work out a future program with the Graduate Advisor.

**Academic Appeals Procedure**

The Department of Physics and Astronomy has established an appeals procedure to ascertain that student's academic performance was evaluated in an orderly manner, without prejudice or caprice, and without violating the right to due process.

Before the student files a formal appeal, he/she must schedule an appointment for an informal discussion with the faculty member responsible for evaluating the student.

If the student and faculty member cannot resolve the academic problem on an informal basis, then the student should submit a written appeal to the faculty member, to the Chairperson of the department, and to the Graduate Advisor. If the problem is not satisfactorily resolved at the department level within a reasonable period of time, the student can submit a written appeal to the Dean of the College of Liberal Arts and Sciences.

If the appeal procedures within the College of Liberal Arts and Sciences have been exhausted without a satisfactory resolution of the problem, the student may request the Provost to review the decision. Procedures for both requesting a Provostial review and for a postponement of a College's final decision are specified in the University Bulletin.

## USUAL SCHEDULING OF PHYSICS COURSES OPEN TO GRADUATE STUDENTS

FALL SEMESTER			Credits	WINTER SEMESTER			Credits
5100	Methods of Theoretical Phys I	3		5010	Astrophysics and Stellar Astronomy*	3	
5200	Classical Mechanics I	3		5030	Plasma Physics*	3	
5620	Electronics and Electrical Measurements	5		5210	Classical Mechanics II	3	
5750	Biological Physics	4		5340	Optics	3	
6410	Quantum Physics II	3		5341	Optics Lab	2	
6480	Quantum Computing	3		6400	Quantum Physics I	3	
6500	Thermo and Statistical Phys	4		6450	Intro. Materials and Device Char.	4	
6570	Smart Sensor Technology I*	4		6610	Electromagnetic Fields II	3	
6600	Electromagnetic Fields I	3		6780	Research in Biomedical Physics	3	
6750	Applied Computational Meth	2		6850	Modern Physics Lab I	2	
6991	Special Topics – Graduate Research Seminar <sup>Δ</sup>	1		6860	Computational Physics	3	
7110	Methods of Theoretical Phys II	3		7050	Survey of Condensed Matter Phys	3	
7200	Advanced Mechanics	3		7060	Survey of Elementary Particles Phy	3	
7400	Quantum Mechanics I	3		7070	Survey of Nuclear Physics	3	
7500	Statistical Mechanics	4		7410	Quantum Mechanics II	3	
7550	Advanced Condensed Matter Physics: Solid State*	3		7560	Advanced Condensed Matter Physics: Soft Matter*	3	
7610	Electromagnetic Theory II*	3		7580	Smart Sensor Technology II	4	
8800	Advanced Nuclear Physics*	3		7600	Electromagnetic Theory I	3	
8850	Quantum Theory of Fields I*	3		8570	Smart Sensor Technology Seminar	1	
8991	Special Topics Seminar <sup>Δ</sup>	1		8810	Advanced Particle Physics*	3	
8995	Colloquium	1		8860	Quantum Theory of Fields II*	3	
				8991	Special Topics Seminar <sup>Δ</sup>	1	
				8995	Colloquium	1	

\*The courses 5010, 5030, 6570, 7550, 7560, 7610, 8800, 8810, 8850 and 8860 will be offered in alternate academic years or sooner if there is sufficient enrollment/interest.

<sup>Δ</sup>Under PHY 6991 "Special Topics", the Department expects to offer a Research Seminar each fall semester. The speakers are faculty members who will emphasize the general objectives, physical ideas, principles, and techniques employed in their research. The course is intended to acquaint senior undergraduates and new graduate students with various research programs.

<sup>Δ</sup>PHY 8991 is a one-credit Special Topics Seminar. Various sections may be scheduled in the same semester on a variety of research areas, including, for example, Condensed Matter Physics, Nuclear Physics, and High-Energy Physics.

## **Ph.D. REQUIREMENTS**

### **Course Requirements**

A minimum of 90 semester credits is necessary for completion of the Ph.D. program.

The 90 credits must be made up of the following requirements:

1. Six 7000 or higher-level courses which must include PHY 7110, 7400, 7500 and one of either PHY 7050 or 7060 or 7070. A student not already having had the equivalent of PHY 5100 should also take that course. Additional 7000 level courses include PHY 7200, 7410, 7600 and 7610. Students specializing in condensed matter physics must take either PHY 7550 or PHY 7560 (or both if recommended by the Research Advisor). Students specializing in nuclear physics must take PHY 8800 and those specializing in particle physics must take PHY 8810. Students specializing in theoretical physics are encouraged to take PHY 8850 and 8860.
2. 30 hours of PHY 9991 to 9994, Doctoral Dissertation Research and Direction.

Note that up to 30 hours of credit earned toward a Master's degree at another institution may be transferred and appear on the PLAN OF WORK if the grade of A or B was earned. However, all the credits at Wayne State University for a Master's degree may appear on the PLAN OF WORK. However, the non-physics courses must be approved by the Graduate Advisor/Research Advisor.

It is to be noted that the University minor requirement (of a graduate student taking 6 credits in a department other than their major department) has been waived for physics majors since they receive extensive mathematical training through PHY 5100 and 7110, and also through the direct experience that most of our students obtain in the usage of computers in their dissertation research.

On petition of the student and his/her dissertation advisor, the Departmental Graduate Committee may consider waiving any of the course requirements listed in Item 1 above. However, the student must display exceptional knowledge of the relevant subject matter. It should also be noted that the student's dissertation advisor might require him/her to take additional courses if those courses are relevant to the student's field of specialization.

### **Research and Dissertation Courses**

**Physics 9990-9999** - Doctoral Dissertation credits (of which exactly 30 credits are required) should usually be taken only after satisfactory completion of the Qualifying Exam and after being advanced to the rank of Ph.D. Candidate. The Ph.D. Candidate is required to register for four consecutive semesters of Candidate Status; spring/summer registration is optional. During each of the four semesters, the Candidate will be assessed tuition for 7.5 graduate credits at the resident rate (i.e., one fourth the cost of 30 graduate credits).

The Candidate Maintenance Status will be available if a student does not complete the dissertation and the defense by the end of the four semesters of Candidate Status registration. The Maintenance Status allows students access to University resources – libraries, computer systems, laboratories and faculty advising.

A sequence of courses for the Candidate Status and Candidate Maintenance Status has been established.

PHY 9991 Candidate Status I Doctoral Dissertation Research and Direction  
PHY 9992 Candidate Status II Doctoral Dissertation Research and Direction  
PHY 9993 Candidate Status III Doctoral Dissertation Research and Direction  
PHY 9994 Candidate Status IV Doctoral Dissertation Research and Direction  
PHY 9995 Candidate Maintenance Status

The Ph.D. Candidate will register for these courses in sequence, and, if needed, the Maintenance Status course. For applicants who wish to register as pre-Doctoral Candidate, a course, PHY 9990, is made available for pre-dissertation research. Registration of up to 10 credits will be permitted in this course.

Students may register for regular courses in the same semester they register in Candidate Status I or II or III or IV. A student is considered withdrawn from the Ph.D. program if he or she fails to register for any of the required four consecutive semesters beginning with the term following the advancement to Ph.D. candidate status. Students in Candidate Maintenance Status are required to register if they are using University resources during a semester. They must be registered for the semester in which they defend the dissertation.

**Physics 7996** - Research in Physics may be taken at any time; however, a maximum total of 12 hours of 7996 is allowed.

**Physics 8991** - Special Topics Seminar. The number of allowed credits must be determined in consultation with the Graduate Advisor.

### **Other Restrictions**

**Physics 7990** - Directed Study. A maximum total of 6 credit hours are allowed (see page 7 for more details).

**Physics 8995** - Colloquium. This course must be taken every semester in which the student is enrolled as a graduate student unless doing so would cause the student to exceed the number of credits paid for by his/her assistantship. However, only 4 hours of credit in 8995 will be allowed on a student's PLAN OF WORK.

### **Qualifying Examination**

The purpose of the Qualifying Examination in the Department of Physics and Astronomy is to identify those graduate students who have sufficient background in physics, as well as the necessary intellectual capacity, dedication and drive, to pursue their doctoral degree. The Qualifying Examination consists of a written part and an oral part. The written part of the Qualifying Exam is given twice a year, once in January and once in May, and students must take it as soon as the recommended prerequisite courses have been completed. At the latest, the Exam must be taken for the first time no later than the end of the student's second academic semester (even if the student has entered the Physics Ph.D. program in the winter semester). The examination will consist of 4 2-hours written parts given over two days. Students taking the Exam will either completely pass or completely fail the Qualifying Exam; there will be no partial passing of the Exam. Students, however, will have two consecutive opportunities to

pass the Exam. New incoming graduate students will be allowed to take the qualifying exam at the end of their first semester as a free trial. If student fails the exam taken at the end of first semester, he/she will still have two more consecutive chances to take it. The Qualifying Exam will be composed of a mix of problems written by the faculty, and problems adapted from published compilations. The Exam consisting of problems similar to those administered at other Universities is considered a more universal and standardized measure of the student's readiness for the Ph.D.

According to the policy of the Graduate School, the oral portion of the Qualifying Exam has to be completed within two months of passing the written part. In our Department we have treated the Ph.D. prospectus presentation as the fulfillment of the oral exam requirement of the Graduate School. However, since it is hard for a student to complete Ph.D. dissertation prospectus within two months (60 days) of passing the written part of the Qualifying Exam, we have generally allowed up to one year (after passing the written part of Qualifying Exam) to complete the oral part of the Exam. The oral exam would cover materials and topics more closely associated with student's dissertation research area. Thus it would be appropriate to compose the oral exam committee from the research area of the student. Often the members of the qualifying oral exam committee will also serve as the members of the student's dissertation committee, though it is not necessary.

A Ph.D. applicant is expected to have a good working knowledge of **basic** Physics. As an appropriate test of the graduate student's background and understanding, the Qualifying Examination includes material that is normally covered in **basic and** advanced undergraduate courses by a student obtaining a B.S. in the General Physics Option. In particular, the Qualifying Examination is aimed at the level and sophistication of courses encountered by Wayne State University undergraduate physics majors. Specifically, a graduate student in physics who has successfully completed PHY 5200, 5500, 6400, 6400, and 6600, **as well as lower level courses**, will have sufficient background to pass the Qualifying Exam. As an aid, the textbooks for various physics courses most recently used at Wayne State are listed on pages 18-19.

In addition, the extent and depth of topics covered on the Qualifying Exam are typified by previous Qualifying Exams that are available from the main office, Room 135. Of course, the level and content of any particular exam may vary from year to year. The intent, however, is to maintain a consistent level of rigor, and the old exams thus provide an excellent guide.

### **Masters Degree Under Plan C**

After successful completion of the Ph.D. prospectus, the doctoral candidate will be eligible to earn a masters degree in physics under Plan C. Please consult the Graduate Advisor for details.

### **Dissertation Advisor, Dissertation Outline, and Doctoral Committee**

The student should seek a dissertation advisor as early in his/her career as possible – preferably prior to taking the Qualifying Exam. The DOCTORAL DISSERTATION OUTLINE AND RECORD OF APPROVAL form includes a Prospectus of the proposed dissertation research and should be put together with the student's advisor. A Prospectus is a carefully detailed elaboration of the topics, covered in the outline, which will eventually form the basis of student's doctoral dissertation. It normally would

be at approximately 20 to 30 double-spaced pages long. See the Graduate Advisor for details. *The Graduate School strictly enforces the Prospectus requirement.* At this time, the student's Doctoral Committee is selected. It consists of at least three members of the Department of Physics and Astronomy (including the student's advisor) and one member of another department of the University. The student should now make an oral presentation of the Prospectus to the Doctoral Committee and it will serve to fulfill the oral exam requirement of the Graduate School. The relevant form is approved by the student's dissertation advisor and the Graduate Advisor. Following departmental approval, all copies of the Prospectus are forwarded to the Graduate School Office for the Dean's signature and approval.

### **Residence Requirement**

The Ph.D. requirement of one year of residence is met by the completion of at least six graduate credits in course work, exclusive of dissertation, in each of the two successive semesters. The spring-summer semester may be excluded from the definition of successive semesters.

In the experimental sciences for which it can be demonstrated that a student's research must be completed on campus, the residence requirement for the Ph.D. degree may be met by the dissertation advisor's written certification that the student has been in full-time residence for at least two successive semesters and one summer session. In this latter case, a count of course credits is not required for the fulfillment of the residence requirement, but specific dates of residence must be furnished. In addition, the Ph.D. residence requirements stipulate that the student must elect at least 30 credits in graduate work exclusive of dissertation direction at the University.

### **Transfer of Graduate Credits**

A student wishing to secure credit toward an advanced degree at Wayne State University for graduate credit earned at another graduate institution may file a petition, approved by his or her Graduate Advisor, requesting such transfer. Transfer of credits previously earned will be considered only if the course work appears on an official graduate transcript of the original institution. Petitions will not be approved unless a minimum grade of B was earned. B minus credit is not acceptable for transfer. Transfer credit cannot be used to meet the residence requirement for the Ph.D. Students are advised that previously earned graduate credits may be transferred only if, in the judgment of the Graduate Advisor/Graduate Committee, it is applicable to the degree program of the individual. (As stated earlier, a maximum of 30 semester credits earned towards a Master's degree at another institution may be transferred and appear on the Plan of Work.)

### **Switching to Ph.D. from Master's Program**

When a student has completed the requirements for the Master's degree or wants to switch from the Master's to the Ph.D. program without completing the Master's degree, he/she must file a Change of Status request. Forms are available on the Graduate School's webpage.

### **Dissertation and Admission to Ph.D. Candidacy**

A student should begin to work directly on his/her dissertation after he/she becomes a Ph.D. candidate. A Ph.D. applicant will be advanced to the rank of Ph.D. candidate

when he/she passes the Ph.D. qualifying exam. The student may then register for the dissertation research courses, PHY 9991 to 9994. (Refer to page 6 and page 10 for additional information on the scheduling of dissertation credit.)

A student must prepare a dissertation based upon original research and under the supervision of a member of the graduate faculty of the Department of Physics and Astronomy. At least 4 copies must be prepared, one for the dissertation advisor, one for the student, and two for the University. The two copies submitted to the University are submitted unbound and in separate envelopes. Eventually, one of these copies goes to the University Library and one is returned to the Department of Physics and Astronomy.

In preparation of the dissertation, it is essential that the student follow the "Guide for Preparing Theses and Dissertation," copy of which is available on the Graduate School webpage. The style to be used by students in our department for footnotes, bibliographies, tables, chapter headings, etc., is that of the American Institute of Physics Style Manual, which is available on the webpage [aip.org](http://aip.org). Most faculty members in our department probably have their own personal copy of the style manual that they may be willing to make available to students working with them.

After the dissertation advisor has approved the dissertation, it should be submitted to the Graduate School. The final acceptance of the dissertation is made after the presentation of the dissertation. This presentation takes the form of an oral presentation that is publicized and open to the public. At this lecture, the candidate will outline the methodology, research, and the results of his/her investigation. Immediately after this presentation, the doctoral committee will question the candidate.

### **Due Date for the Submission of Dissertation**

These dates precede the end of the fall and winter semesters by about one month; therefore, you must check the time schedule issued by the Graduate School. The dissertation advisor must see the dissertation long before such dates.

### **Graduation**

Each candidate for a degree must file an APPLICATION FOR DEGREE by the deadline given in the academic calendar for the semester in which he/she expects to complete the requirements for the degree. If an application for a degree was filed for a previous semester in which a student did not graduate, a new application is necessary. The student **MUST** have registered for at least one credit in the semester just prior to graduation.

### **Time Limitation**

There is a seven-year time limit on the completion of the requirements for the Ph.D. degree. This begins at the end of the semester during which the student is admitted as a doctoral applicant. (*Note: This status, putting one officially into a doctoral program, comes prior to the status of doctoral candidate that comes after passing the qualifying exam.*) Candidates who put off finishing for an inordinate amount of time cannot expect the department to automatically continue to support them.

## **MASTER'S DEGREE REQUIREMENTS**

### **Course Requirements**

#### *Master of Science degree*

24 semester credits in course work plus an 8-credit Thesis

#### *Master of Arts degree*

29 semester credits in course work plus a 3-credit Essay

At least half of the course work must be in physics. At least 9 credits of course work (exclusive of PHY 7990, 7996, 7999, 8995, 8999) must be at the 7000 level (or above) in physics.

There is a 24-credit residency requirement for the Master's degree. This means that a maximum of 8 credits may be transferred from another institution to fulfill the 32-hour total credit requirement for the degree. (Transferred credits must be certified as graduate-level with the grade of B or better on an official transcript, and quarter system credits will be converted to equivalent semester credits.)

At either the graduate or undergraduate level, the student should have completed the following courses or their equivalent.

Physics	5210	Classical Mechanics II
Physics	5500	Thermal Physics
Physics	6600	Electromagnetic Fields I
Physics	6610	Electromagnetic Fields II

Two semesters of quantum physics at the level of PHY 6400 (Quantum Physics I) and 6410 (Quantum Physics II) or above.

Mathematics through Math 5070 and PHY 5100, or equivalent courses.

### **PLAN OF WORK**

For all completed courses appearing on the PLAN OF WORK for the Master's degree, the grade point average must be maintained at 3.0 or better. In addition, the student's overall average (which includes completed courses whether or not they are on the PLAN OF WORK) must be 3.0 or better at the time the PLAN is submitted and at the time of graduation.

Any credits of PHY 7996 (Research in Physics) or PHY 7990 (Directed Study) will be allowed on the PLAN OF WORK at the discretion of the Graduate Advisor.

The PLAN should be made as soon as possible and, certainly, no later than the close of the semester in which 8-12 hours of work are completed. A student cannot register in additional courses beyond 12 hours until his or her PLAN has been approved. The PLAN OF WORK is made in conjunction with the Graduate Advisor who will then forward it to the Graduate Office of the College of Liberal Arts and Sciences. The student should obtain a thesis or essay advisor as soon as possible.

### **Changes in Plan of Work**

The student may change the PLAN OF WORK with the approval of the Graduate Advisor by completing the appropriate form. The advisor will then forward it to the College of Liberal Arts and Sciences Graduate Office.

### **Thesis or Essay**

The student must seek out an adviser for either the thesis research or the essay. This should be done well in advance of the semester in which the thesis or essay work is to begin. For the Master's thesis, PHY 8999, 8 credits (no more and no less) are required, and it is anticipated that the thesis research would be spread over at least 2 semesters. The essay, PHY 7999, consists of 3 credits (no more and no less) and sometimes requires longer than one semester from beginning to completion.

### **Research**

The student may elect Research in Physics credits, PHY 7996, with prior approval of the faculty member supervising that research as well as the Graduate Advisor; *however, the student must be actually carrying out research other than masters thesis research.* The number of hours of research allowed on the PLAN OF WORK may be restricted (normally not more than 3 credits will be allowed on the PLAN OF WORK) by the advisor and the Graduate Committee.

### **Master's Thesis**

The student must first find a faculty member of the Department of Physics and Astronomy who will agree to supervise the thesis work. The student and thesis advisor must then decide upon a suitable thesis topic. At this point, the student should complete the form, "MASTER'S THESIS-OUTLINE AND RECORD OF APPROVAL." This form should be approved by the thesis advisor and then presented to the Graduate Committee of the Department of Physics and Astronomy. The form is to be completed in triplicate, one for the student, one for the Department and one to be submitted to the College of Liberal Arts and Sciences Graduate Office. The thesis work may then be initiated, and the student cannot change the subject or thesis advisor without repeating this procedure again. In preparing the thesis, at least three copies must be prepared. After approval of the thesis, one copy is to be submitted unbound in an envelope to the College of Liberal Arts and Sciences Graduate Office. The second copy is for the thesis advisor. The third copy is for the student. In addition, two copies of an abstract of the thesis must be approved and submitted with the thesis.

In preparation of the thesis, it is essential that the student follow the "Guide for Preparing Theses and Dissertations," copy of which is available on the Graduate School webpage. The style to be used by students in our department for footnotes, biographies, tables, chapter headings, etc., is that of the American Institute of Physics Style Manual. Copies of the AIP Style Manual are available online at [aip.org](http://aip.org). Most faculty members in our department probably have their own personal copy of the style manual that they may be willing to make available to students working with them.

For additional information, see the relevant sections of the Wayne State Graduate Bulletin.

**Master's Essay**

The student must find a faculty member of the Department of Physics and Astronomy who will agree to supervise the essay. The student and his/her essay advisor must decide upon a suitable topic for the essay. Three copies of the essay must be prepared and bound. One copy is submitted to the Graduate Office of the College of Liberal Arts and Sciences. This copy is returned to the Department. The second copy of the essay is for the advisor and the third copy is for the student.

In preparing the essay, the same general form and care should be used as is required for the thesis.

**Oral Examination**

The Department of Physics and Astronomy requires that each student pass an oral examination after completion of the thesis or essay. This oral examination should be arranged with the thesis/essay advisor who, together with the student, will select two additional members of the department to serve on the oral committee. The examination will be directed primarily towards the student's thesis or essay; however, questions may be asked concerning his/her general background in physics.

**Due Date for the Thesis and Essay Submission**

These dates precede the end of the fall and winter semesters by about one month; therefore, you must check the time schedule issued by the Graduate School. The thesis/essay advisor must see the thesis or essay long before such dates.

**Graduation**

Each candidate for a degree must file an APPLICATION FOR DEGREE by the deadline given in the academic calendar for the semester in which he/she expects to complete the requirements for the degree. If an application for a degree was filed for a previous semester in which a student did not graduate, a new application is necessary. The student **MUST** have registered for at least one credit in the semester just prior to Graduation.

**Time Limitation**

Students have a six-year limit to complete all requirements for the Master's degree. The six-year period begins at the end of the first semester during which the student started work that applies toward meeting Master's degree requirements.

## **BACKGROUND FOR THE Ph.D. QUALIFYING EXAMINATION**

The following descriptions go into more specifics concerning the topics and typical texts used by a Wayne State undergraduate in obtaining a B.S. in the General Physics option. The pertinent advanced undergraduate courses taken by physics majors at Wayne State are: PHY 5200, 6400, 6500 and 6600. If you have any questions, please see the Chair of the Qualifying Exam Committee or the Graduate Advisor.

### **Mechanics:**

#### ***Textbooks Used:***

*Classical Dynamics of Particles and Systems* by J. B. Marion and S. T. Thornton  
*Classical Mechanics* by John R. Taylor

#### ***Topics Covered:***

Newtonian Mechanics, Oscillations, Gravitation, Calculus of Variations, Lagrangian Dynamics, Central Force Motion, Dynamics of a System of Particles, Mechanics in Noninertial Reference Frames, Dynamics of Rigid Bodies, Coupled Oscillations and Normal Modes, Hamiltonian Mechanics

### **Thermodynamics and Statistical Physics:**

#### ***Textbooks Used:***

*Classical and Statistical Thermodynamics* by Ashley H. Carter  
*An Introduction to Thermal Physics* by Daniel V. Schroeder  
*Thermodynamics, Kinetic Theory, and Statistical Thermodynamics* by F. W. Sears and G. L. Salinger

#### ***Topics Covered:***

Equation of State, First, Second and Third Laws of Thermodynamics and their Applications, Thermodynamic Potentials, Statistical Thermodynamics, Classical and Quantum Statistics, Bose-Einstein and Fermi-Dirac Gases

### **Electricity and Magnetism:**

#### ***Textbooks Used:***

*Introduction to Electrodynamics* by David J. Griffiths  
*Electromagnetism* by G. L. Pollack and D. R. Stump

#### ***Topics Covered:***

Electrostatics, General Methods for Solving Poisson's and Laplace's Equations, Dielectrics, Magnetostatics, Magnetic Fields in Matter, Electromagnetic Induction, Maxwell's Equations, Electromagnetic Waves and Their Radiation, Reflection and Refraction of Electromagnetic waves, Electromagnetism and Relativity

### **Quantum Mechanics:**

**Textbooks Used:**

*Introduction to Quantum Mechanics* by David J. Griffiths  
*Quantum Physics* by Stephen Gasiorowicz

**Topics Covered:**

Time-independent Schrodinger Equation, Eigenfunctions and Eigenvalues: The Probability Interpretation, One-dimensional Potentials, Operator Methods, Identical Particles, Quantum Mechanics in Three-dimensions, Hydrogen Atom, Angular Momentum, Spin, Time-independent Perturbation Theory, One-dimensional Scattering Theory.

**Modern Physics:****Textbooks Used:**

*Modern Physics* by Serway, Moses and Moyer  
*Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles* by R. Eisberg and R. Resnick

**Topics Covered:**

Special Relativity, DeBroglie's Postulate, Bohr's Model of the Atom, Schrodinger's Equation and its Solutions, One-electron Atoms, Magnetic Dipole Moments, Spin and Transition Rates

**Introductory Physics:****Textbooks Used:**

*University Physics 1*, 1<sup>st</sup> Edition, <https://openstax.org/details/books/university-physics-volume-1>  
*University Physics 2*, 1st Edition, <https://openstax.org/details/books/university-physics-volume-2>  
*Fundamentals of Physics*, 10<sup>th</sup> Edition, Halliday, Resnick and Walker

**Topics Covered:**

Statics, kinematics, dynamics, energy and linear momentum, rotational kinematics and dynamics, angular momentum, solids and fluids, vibrations and wave motion, thermodynamics. Electric forces and electric fields, electrical energy, capacitance, current, resistance, direct current circuits, magnetism, induced voltage and inductance, AC circuits, electromagnetic waves, geometric and wave optics.

**CHECKLIST OF Ph.D. DEGREE REQUIREMENTS**

*Note: Students should watch for announcements of Ph.D. degree procedure deadlines by the Graduate School Office.*

- \_\_\_\_\_ If initially in Master's program, file Change of Status request in the College of Liberal Arts and Sciences Graduate Office for admission into Ph.D. program.
- \_\_\_\_\_ Prepare PLAN OF WORK as soon as possible in consultation with the Graduate Advisor. The PLAN OF WORK must be submitted before taking the Ph.D. Qualifying Exam.
- \_\_\_\_\_ Take (and pass) the Ph.D. Qualifying Exam.
- \_\_\_\_\_ Submit DOCTORAL DISSERTATION OUTLINE AND RECORD OF APPROVAL to dissertation advisor.
- \_\_\_\_\_ Submit approved DOCTORAL DISSERTATION OUTLINE AND RECORD OF APPROVAL to Departmental Graduate Advisor for departmental approval. (*Note: This OUTLINE and APPROVAL should be submitted prior to registering for Dissertation Research, namely, Candidate Status I, PHY 9991.*)
- \_\_\_\_\_ File an APPLICATION FOR DEGREE during registration period of the semester when requirements are expected to be completed.
- \_\_\_\_\_ Submit a copy of Ph.D. dissertation to thesis advisor for approval.
- \_\_\_\_\_ Submit a copy of dissertation for approval of format and appearance to Graduate School Office.
- \_\_\_\_\_ Prepare at least three copies of Ph.D. dissertation.
- \_\_\_\_\_ Submit FINAL REPORT/DISSERTATION PUBLIC LECTURE PRESENTATION DEFENSE form to Graduate School Office with committee signatures for dissertation approval.
- \_\_\_\_\_ Present dissertation at an open, publicized lecture with subsequent questioning by doctoral committee.
- \_\_\_\_\_ Submit one copy of dissertation (with original signatures) to Graduate School Office.
- (To advisor:)
- \_\_\_\_\_ All grade changes (e.g., Y and I) should be turned in to the Graduate School Office.

**CHECKLIST OF MASTER'S DEGREE PROCEDURES:**

Note: Students should watch for announcements of Master's degree deadlines by the College of Liberal Arts and Sciences Graduate School Office.

\_\_\_\_\_ As soon as possible make a PLAN OF WORK in conjunction with the Graduate Advisor. (No later than the close of the session in which 8-12 hours of work are completed.)

\_\_\_\_\_ Submit MASTER'S THESIS OUTLINE AND RECORD OF APPROVAL to thesis advisor for approval.

\_\_\_\_\_ Submit approved MASTER'S THESIS-OUTLINE AND RECORD OF APPROVAL to Graduate Advisor for departmental approval.

\_\_\_\_\_ File an APPLICATION FOR DEGREE during registration period of the semester when requirements are expected to be completed.

\_\_\_\_\_ Prepare a final draft of Master's Thesis for approval of thesis format and appearance by the College of Liberal Arts and Sciences Graduate Office.

\_\_\_\_\_ Prepare three copies of Master's Thesis or Master's Essay.

\_\_\_\_\_ Arrange for oral examination with Thesis/Essay advisor and two other faculty members.

\_\_\_\_\_ Submit approved Thesis/Essay to Graduate Office of the College of Liberal Arts and Sciences. Two additional copies of Thesis abstract must be approved and submitted.

*To Graduate Advisor:*

\_\_\_\_\_ Advisor fills out FINAL REPORT form and attaches student's cumulative record.

\_\_\_\_\_ All grade changes (e.g. Y and I) should be turned in to the College of Liberal Arts and Sciences Graduate School Office.