PHYSICS, PHD

Banner Code: SC-PHD-PHYS

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The degree program contains a Standard Concentration for traditional physics programs that focus on Astrophysics, Condensed Matter Theory, Dynamical Systems/Biological Physics, High Energy Physics, Materials Physics, Space Sciences, and an Engineering Physics Concentration that combines the disciplines of physics, mathematics, and engineering. The doctoral students accepted into each concentration of the physics PhD program take a required set of core courses for the given concentration (see Requirements tab).

By working with the dissertation committee, a student in the Standard Concentration may choose to specialize in an emphasis area such as Astrophysics, Condensed Matter Theory, Dynamical Systems/Biological Physics, High Energy Physics, Materials Physics, Space Sciences, or others according to his or her particular interests. A student in the Engineering Physics Concentration may choose to specialize in Applied Mechanics, or other applied and engineering physics areas. By the end of their first year, all students should pair with a faculty advisor who will guide them toward doctoral candidacy.

Admissions & Policies

Admissions

University-wide admissions policies can be found in the Graduate Admissions Policies section of this catalog.

To apply for this program, please complete the George Mason University Admissions Application (https://www2.gmu.edu/admissions-aid/apply-now).

Those holding a baccalaureate degree in physics, astronomy, or engineering from a regionally accredited institution, who earned a GPA of 3.00 (out of 4.00) or higher in their last 60 credits, and received acceptable scores on the GRE-GEN are invited to apply for admission. Three letters of recommendation must be submitted, preferably from former professors. The GRE subject test in physics is highly recommended for all interested applicants in the standard concentration who received their baccalaureate degrees within the past five years. A degree-seeking graduate applicant with a baccalaureate degree who has not met all admission requirements may be offered provisional admission if sufficient evidence is presented to suggest that the applicant has the ability to pursue graduate work. For more details concerning admission requirements to George Mason University please refer to Graduate Admission Policies.

Policies

For policies governing all graduate programs, see AP.6 Graduate Policies.

Reduction of Credits

For students entering the doctoral program with a master’s degree in a related field from a regionally accredited institution, the number of required credits may be reduced up to 30 credits, subject to approval of the program faculty and the college's associate dean. See AP.6.5.2 Reduction of Credits for more information.

Requirements

Degree Requirements

Total credits: 72

Students should refer to the Admissions & Policies tab for specific policies related to this program.

Students must first choose one concentration, then continue with the additional sections:

Standard Concentration (STND)

<table>
<thead>
<tr>
<th>Core Courses</th>
<th>12</th>
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<tbody>
<tr>
<td>PHYS 684</td>
<td>Quantum Mechanics I</td>
</tr>
<tr>
<td>PHYS 685</td>
<td>Classical Electrodynamics I</td>
</tr>
<tr>
<td>PHYS 705</td>
<td>Classical Mechanics</td>
</tr>
<tr>
<td>PHYS 711</td>
<td>Statistical Mechanics</td>
</tr>
</tbody>
</table>

Specialty Science Courses | 6
Select two of the following courses:
- ASTR 680 Physics of Interstellar Media
- ASTR 730 Stellar Astrophysics
- PHYS 784 Quantum Mechanics II
- PHYS 785 Classical Electrodynamics II

Seminar Course | 3
- PHYS 703 Seminar in Physics (must be taken three times)

Total Credits | 21

Engineering Physics Concentration (ENGP)

<table>
<thead>
<tr>
<th>Core Courses</th>
<th>12</th>
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<tbody>
<tr>
<td>PHYS 510</td>
<td>Computational Physics I</td>
</tr>
<tr>
<td>PHYS 613</td>
<td>Computational Physics II</td>
</tr>
<tr>
<td>PHYS 620</td>
<td>Continuum Mechanics</td>
</tr>
<tr>
<td>PHYS 690</td>
<td>Engineering Thermodynamics</td>
</tr>
</tbody>
</table>

Specialty Science Courses | 6
Select two of the following courses:
- PHYS 640 Finite Element Analysis of Solids and Fluids
- PHYS 694 Applied Mechanics of Solids
- PHYS 695 Applied Fluid Mechanics
- PHYS 684 Quantum Mechanics I
- PHYS 685 Classical Electrodynamics I

Seminar Courses | 3
- PHYS 703 Seminar in Physics (at least one credit required)
Qualifying Examination

All students must successfully pass the four individual sections required for each concentration of a qualifying examination. For the Standard Concentration, the four topics on the qualifying exam are covered in the four core courses (PHYS 684 Quantum Mechanics I, PHYS 685 Classical Electrodynamics I, PHYS 705 Classical Mechanics, and PHYS 711 Statistical Mechanics). For the Engineering Physics Concentration, the four topics on the qualifying exam are covered in the four core courses (PHYS 690 Engineering Thermodynamics or PHYS 711 Statistical Mechanics, PHYS 620 Continuum Mechanics or PHYS 705 Classical Mechanics, PHYS 510 Computational Physics I and PHYS 613 Computational Physics II) and in one of the specialty science courses (PHYS 694 Applied Mechanics of Solids or PHYS 695 Applied Fluid Mechanics).

All four sections of the qualifying exam will be offered twice a year, typically in the week before the start of the fall and spring semesters. A student can choose to take a particular section or a combination of sections at one sitting. Grades of “pass” or “unsatisfactory” will be given individually for each of the four sections of the exam. If a student receives a grade of “unsatisfactory” in a given section of the exam, he/she is allowed to retake that section in the next cycle, but a student must satisfactorily pass all sections of the exam by the end of the third year from the date of enrollment in the PhD program. Students entering the program with equivalent courses taken at another institution can satisfy a core course requirement by taking the associated qualifying exam without taking the course.

At the beginning of each academic year, the program director will appoint members to the qualifying examination committee. This committee is responsible for creating, administering, and grading the qualifying exams offered that year. Additional information and previous qualifying exams can be found on the departmental web page.

Dissertation Committee and Program of Study

Upon successful completion of the qualifying examinations, a dissertation committee should be formed by the student as soon as possible. The chair of this committee must be a graduate faculty member from the Department of Physics and Astronomy. The committee must include at least two additional members from the graduate faculty, one of whom must be from outside the Department of Physics and Astronomy. The composition of the committee should be approved by the program director. The dissertation committee is responsible for directing the student in their chosen field of research. The student should work closely with their committee to select specialty courses and electives that form a cohesive program of study. The student’s program of study must be approved by the dean before advancement to candidacy.

Advancement to Candidacy

Before a student may be advanced to doctoral candidacy, he/she needs to complete all required coursework, pass the qualifying examination, have the program of study and dissertation proposal approved by the dean, and be recommended by the dissertation committee. Advancement to doctoral candidacy implies that the student has demonstrated adequate breadth and depth of knowledge in the field of study and is capable of conducting research on the boundaries of knowledge.

Dissertation Research

Note: No more than 24 combined credits from PHYS 998 Doctoral Dissertation Proposal/ASTR 998 Doctoral Dissertation Proposal and PHYS 999 Doctoral Dissertation/ASTR 999 Doctoral Dissertation may be applied toward satisfying the doctoral degree requirements, with no more than 12 credits of PHYS 998 Doctoral Dissertation Proposal/ASTR 998 Doctoral Dissertation Proposal.

Select 24 credits from the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR 998</td>
<td>Doctoral Dissertation Proposal</td>
<td>24</td>
</tr>
<tr>
<td>ASTR 999</td>
<td>Doctoral Dissertation</td>
<td></td>
</tr>
<tr>
<td>PHYS 998</td>
<td>Doctoral Dissertation Proposal</td>
<td></td>
</tr>
<tr>
<td>PHYS 999</td>
<td>Doctoral Dissertation</td>
<td></td>
</tr>
</tbody>
</table>

Total Credits 24

Doctoral Dissertation

After advancing to doctoral candidacy, the student works with their dissertation committee to develop their preliminary research into a doctoral dissertation. The dissertation research should represent a significant contribution to its scientific field and should be deemed publishable in a refereed scientific journal. The dissertation must be defended in a public forum before the dissertation committee and other interested faculty.