PHYSICS, BS

Banner Code: SC-BS-PHYS

Undergraduate Physics Advisor

203 Planetary Hall Fairfax Campus

Phone: 703-993-5356 Email: uadvstr@gmu.edu Website: physics.gmu.edu

The Physics, BS program prepares students for graduate school and careers in education, business, or industry.

Teacher Licensure

Students who wish to become teachers and plan to seek teacher licensure should consider the following options:

- Secondary Education Physics (6-12) Undergraduate Certificate (http://catalog.gmu.edu/colleges-schools/education-humandevelopment/school-education/secondary-education-physics-6-12undergraduate-certificate/)
- Physics, BS/Curriculum and Instruction, Accelerated MEd (Secondary Education Physics concentration)

Interested students should attend an information session early in their undergraduate career. For more information, visit the Graduate School of Education's website (http://gse.gmu.edu/).

Admissions & Policies

Admissions

University-wide admissions policies can be found in the Undergraduate Admissions Policies (http://catalog.gmu.edu/admissions/undergraduate-policies/) section of this catalog.

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

Policies

Students must fulfill all Requirements for Bachelor's Degrees (http://catalog.gmu.edu/policies/academic/undergraduate-policies/#ap-5-3-2) including the Mason Core (http://catalog.gmu.edu/mason-core/).

The intensive writing requirement is fulfilled by taking PHYS 407 Senior Laboratory in Modern Physics (Mason Core) (http://catalog.gmu.edu/mason-core/), PHYS 410 Computational Physics Capstone (Mason Core) (http://catalog.gmu.edu/mason-core/), or ASTR 402 RS: Methods of Observational Astronomy (Mason Core) (http://catalog.gmu.edu/mason-core/), which are also capstone courses for the major.

For policies governing all undergraduate programs, see AP.5 Undergraduate Policies (http://catalog.gmu.edu/policies/academic/undergraduate-policies/).

Double Majors

Students considering a double major with physics should discuss this option with the respective undergraduate coordinators.

Note that at least 18 credits used to fulfill the Physics, BS cannot be used to fulfill another major or minor. Some course substitutions are allowed for double majors, but these should be discussed with a physics advisor in advance.

Alternative Introductory Sequence

Normally, students who intend to major in physics should take the physics introductory sequence:

Code	Title	Credits
PHYS 160	University Physics I (Mason Core) (http://catalog.gmu.edu/mason-core/)	3
PHYS 161	University Physics I Laboratory (Mason Core) (http://catalog.gmu.edu/mason- core/)	1
PHYS 260	University Physics II (Mason Core) (http://catalog.gmu.edu/mason-core/)	3
PHYS 261	University Physics II Laboratory (Mason Core) (http://catalog.gmu.edu/mason-core/)	1

Students who decide to major in physics after completing PHYS 243 College Physics I (Mason Core) (http://catalog.gmu.edu/mason-core/), PHYS 244 College Physics I Lab (Mason Core) (http://catalog.gmu.edu/mason-core/), PHYS 245 College Physics II (Mason Core) (http://catalog.gmu.edu/mason-core/) and PHYS 246 College Physics II Lab (Mason Core) (http://catalog.gmu.edu/mason-core/) are welcome, but are required to obtain written permission from the Department of Physics and Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/) before a change of major can be approved.

Requirements

Degree Requirements

Total credits: minimum 120

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

Students must complete a total of 75 credits in the major (69 credits if completing a second major), including at least 11 credits in mathematics, with a minimum GPA of 2.00.

Students must complete the coursework described below and either select a concentration or select the "BS without Concentration" option:

Physics Core Courses

Code	Title	Credits
PHYS 160	University Physics I (Mason Core) (http://	3
	catalog.gmu.edu/mason-core/)	

Total Credits		30
PHYS 416	Undergraduate Physics Review	1
PHYS 402	Introduction to Quantum Mechanics and Atomic Physics	3
PHYS 308	Modern Physics	3
PHYS 307	Thermal Physics	3
PHYS 305	Electromagnetic Theory ¹	3
PHYS 303	Classical Mechanics	3
PHYS 301	Analytical Methods of Physics	3
PHYS 261	University Physics II Laboratory (Mason Core) (http://catalog.gmu.edu/mason- core/)	1
PHYS 260	University Physics II (Mason Core) (http://catalog.gmu.edu/mason-core/)	3
PHYS 251	Introduction to Computer Techniques in Physics	3
PHYS 161	University Physics I Laboratory (Mason Core) (http://catalog.gmu.edu/mason- core/)	1

Students double majoring in engineering and physics may substitute ECE 305 Electromagnetic Theory for PHYS 305 Electromagnetic Theory.

Mathematics

Code	Title	Credits
MATH 113	Analytic Geometry and Calculus I (Mason Core) (http://catalog.gmu.edu/mason- core/)	4
MATH 114	Analytic Geometry and Calculus II	4
MATH 213	Analytic Geometry and Calculus III	3
Total Credits		11

BS without Concentration

Code	Title	Credits
Mathematics/Co	mputational Physics	6
Select 6 credits for	rom the following:	
MATH 203	Linear Algebra	
MATH 214	Elementary Differential Equations	
PHYS 325	Intermediate Methods of Experimental Physics	
Intermediate Lab	oratory	6
PHYS 311	Instrumentation	
PHYS 312	Waves and Optics	
Research, Interns	hip, or Independent Study	3
Select 3 credits for	rom the following:	
PHYS 326	Problems in Physics II	
PHYS 405	Honors Thesis in Physics I	
PHYS 406	Honors Thesis in Physics II	
PHYS 408	Senior Research	
PHYS 409	Physics Internship	
Capstone		4
PHYS 407	Senior Laboratory in Modern Physics (Mason Core) (http://catalog.gmu.edu/ mason-core/) 1	

PHYS 410	Computational Physics Capstone (Mason Core) (http://catalog.gmu.edu/mason- core/) ¹	
Physics Theory		9-15
All students comp	plete the following 9 credits:	
PHYS 306	Wave Motion and Electromagnetic Radiation	
PHYS 403	Quantum Mechanics II	
PHYS 428	Relativity	
•	o are not completing a second major must al credits from the following:	
ASTR 210	Introduction to Astrophysics	
ASTR 328	Stars	
ASTR 403	Planetary Science	
ASTR 404	Galaxies and Cosmology	
PHYS 370	Molecular Biophysics	
PHYS 412	Solid State Physics and Applications	
PHYS 440	Nuclear and Particle Physics	
PHYS 465	Planetary Atmospheres and Ionospheres	
PHYS 475	Atmospheric Physics	
Total Credits		28-34

Fulfills the writing intensive requirement.

Applied and Engineering Physics Concentration (PHAE)

Code	Title	Credits
Mathematics/Comp	outational Physics	3
PHYS 325	Intermediate Methods of Experimental Physics	
Intermediate Labor	atory	6
PHYS 311	Instrumentation	
PHYS 312	Waves and Optics	
Physics Theory		9
PHYS 306	Wave Motion and Electromagnetic Radiation	
Select 6 credits from	m the following:	
PHYS 370	Molecular Biophysics	
PHYS 403	Quantum Mechanics II	
PHYS 412	Solid State Physics and Applications	
Capstone		4
Select 4 credits fro	m the following:	
PHYS 407	Senior Laboratory in Modern Physics (Mason Core) (http://catalog.gmu.edu/ mason-core/) ¹	
PHYS 410	Computational Physics Capstone (Mason Core) (http://catalog.gmu.edu/mason-core/) 1	
Practical Work		6-12
select 12 credits fro	ot completing a second major should om the following. Students who are nd major should select 6 credits:	
PHYS 405	Honors Thesis in Physics I	
PHYS 406	Honors Thesis in Physics II	
PHYS 408	Senior Research	

Total Credits		28-34
Or other appr Engineering o	roved 300 or 400-level Volgenau School of courses	
BENG 320	Bioengineering Signals and Systems	
PHYS 409	Physics Internship	

Fulfills the writing intensive requirement.

Astrophysics Concentration (PHAP)

Code	Title	Credits
	nputational Physics	6
ASTR 401	Computer Simulation in Astronomy	
MATH 214	Elementary Differential Equations	
Intermediate Labo	ratory	6
PHYS 311	Instrumentation	
PHYS 312	Waves and Optics	
Research, Internsl	nip, or Independent Study	3
Select 3 credits fro	· · · · · · · · · · · · · · · · · · ·	
ASTR 405	Honors Thesis in Astronomy I	
ASTR 406	Honors Thesis in Astronomy II	
ASTR 408	Senior Research	
ASTR 409	Astronomy Internship	
PHYS 326	Problems in Physics II	
PHYS 405	Honors Thesis in Physics I	
PHYS 406	Honors Thesis in Physics II	
PHYS 408	Senior Research	
PHYS 409	Physics Internship	
Capstone		4
Select 4 credits fro	om the following:	
ASTR 402	RS: Methods of Observational Astronomy (Mason Core) (http://catalog.gmu.edu/ mason-core/) ¹	
PHYS 407	Senior Laboratory in Modern Physics (Mason Core) (http://catalog.gmu.edu/ mason-core/) ¹	
PHYS 410	Computational Physics Capstone (Mason Core) (http://catalog.gmu.edu/mason- core/) 1	
Physics and Astro	nomy Theory	12-18
Students who a complete the fo	re not completing a second major must ollowing:	
ASTR 210	Introduction to Astrophysics	
ASTR 328	Stars	
Select 2 courses f	rom the following:	
ASTR 403	Planetary Science	
ASTR 404	Galaxies and Cosmology	
ASTR 420	Exoplanets	
ASTR 480	The Interstellar Medium	
PHYS 306	Wave Motion and Electromagnetic Radiation	
PHYS 428	Relativity	
Students who a complete the fo	are completing a second major must ollowing:	
ASTR 210	Introduction to Astrophysics	

	ASTR 328	Stars	
	Additionally, sel	ect 3 credits from the following:	
	PHYS 306	Wave Motion and Electromagnetic Radiation	
	PHYS 428	Relativity	
	Lastly, select 3 o	credits from the following:	
	ASTR 403	Planetary Science	
	ASTR 404	Galaxies and Cosmology	
	ASTR 420	Exoplanets	
	ASTR 480	The Interstellar Medium	
To	otal Credits		31-37

Fulfills the writing intensive requirement.

Computational Physics Concentration (PHCP)

Computational	Physics Concentration (PHCP)	
Code	Title	Credits
Mathematics/Comp	outational Physics	15
PHYS 325	Intermediate Methods of Experimental Physics	
MATH 203	Linear Algebra	
MATH 214	Elementary Differential Equations	
Additionally, sele	ect 6 credits from the following:	
ASTR 401	Computer Simulation in Astronomy	
CDS 302	Scientific Data and Databases	
CDS 303	Scientific Data Mining	
MATH 446	Numerical Analysis I	
MATH 447	Numerical Analysis II	
Intermediate Labor	atory	3
PHYS 311	Instrumentation	
Research, Internshi	ip, or Independent Study	3
Select 3 credits from	m the following:	
PHYS 326	Problems in Physics II	
PHYS 405	Honors Thesis in Physics I	
PHYS 406	Honors Thesis in Physics II	
PHYS 408	Senior Research	
PHYS 409	Physics Internship	
Capstone		4
PHYS 410	Computational Physics Capstone (Mason Core) (http://catalog.gmu.edu/mason-core/) 1	
Physics and Astron	omy Theory	3-9
Students who are not completing a second major must select 9 credits of the following. Students who are completing a second major must select 3 credits from the following:		
ASTR 210	Introduction to Astrophysics	
ASTR 328	Stars	
ASTR 403	Planetary Science	
PHYS 306	Wave Motion and Electromagnetic Radiation	
PHYS 412	Solid State Physics and Applications	
Total Credits		28-34

Fulfills the writing intensive requirement.

Mason Core and Elective Credits

In order to meet a minimum of 120 credits, this degree requires 45 (or 51 if completing a second major) additional credits, which may be applied toward any remaining Mason Core (http://catalog.gmu.edu/mason-core/) requirements (outlined below), Requirements for Bachelor's Degrees (http://catalog.gmu.edu/policies/academic/undergraduate-policies/#ap-5-3-2), and elective courses. Students are strongly encouraged to consult with their advisors to ensure that they fulfill all requirements.

Mason Core

Some Mason Core (http://catalog.gmu.edu/mason-core/) requirements may already be fulfilled by the major requirements listed above. Students are strongly encouraged to consult their advisors to ensure they fulfill all remaining Mason Core (http://catalog.gmu.edu/mason-core/) requirements.

Code	Title	Credits
Foundation	Requirements	
Written Commason-core	munication (ENGH 101) (http://catalog.gmu.edu/ /#written)	3
Oral Commu #oral)	inication (http://catalog.gmu.edu/mason-core/	3
Quantitative #quantitativ	Reasoning (http://catalog.gmu.edu/mason-core/ re)	3
	Technology and Computing (http:// u.edu/mason-core/#information-technology)	3
Exploration	Requirements	
Arts (http://	catalog.gmu.edu/mason-core/#arts)	3
Global Unde #global)	rstanding (http://catalog.gmu.edu/mason-core/	3
Literature (h	ttp://catalog.gmu.edu/mason-core/#literature)	3
Natural Scie #natural-sci	ence (http://catalog.gmu.edu/mason-core/ ence)	7
	Behavioral Sciences (http://catalog.gmu.edu/ /#social-behavioral-science)	3
	ilization/World History (http://catalog.gmu.edu/ /#western-civilization-world-history)	3
Integration I	Requirements	
	nmunications (ENGH 302) (http:// u.edu/mason-core/#written)	3
Writing-Inter	nsive (http://catalog.gmu.edu/mason-core/#wi) ¹	3
	apstone (http://catalog.gmu.edu/mason-core/	3
Total Credits		40

- Most programs include the writing-intensive course designated for the major as part of the major requirements; this course is therefore not counted towards the total required for Mason Core.
- ² Minimum 3 credits required.

Honors

Honors in the Major

Physics majors who have maintained an overall GPA of at least 3.50 in physics courses and a GPA of 3.50 in all courses taken at George Mason

University may apply to the physics honors program when they complete the first semester of their junior year.

To graduate with honors in physics, a student is required to maintain a minimum GPA of 3.00 in physics courses and successfully complete PHYS 405 Honors Thesis in Physics I and PHYS 406 Honors Thesis in Physics II with a GPA of at least 3.50 and a grade of at least 'A-' in PHYS 406 Honors Thesis in Physics II. Please visit the department for details.

Accelerated Master's

Physics, BS/Curriculum and Instruction, Accelerated MEd (Secondary Education Physics concentration)

Overview

Highly-qualified undergraduates may be admitted to the bachelor's/ accelerated master's program and obtain both a BS in Physics and an MEd in Curriculum and Instruction (http://catalog.gmu.edu/colleges-schools/education-human-development/school-education/curriculum-instruction-med/), Secondary Education Physics Concentration in an accelerated time-frame after satisfactory completion of 149 credits. See AP.6.7 Bachelor's/Accelerated Master's Degrees (http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7) for policies related to this program.

This accelerated option is offered jointly by the department of Physics and Astronomy (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/) and the School of Education (http://catalog.gmu.edu/colleges-schools/education-human-development/school-education/).

Students in an accelerated degree program must fulfill all university requirements for the master's degree. For policies governing all graduate degrees, see AP.6 Graduate Policies (http://catalog.gmu.edu/policies/academic/graduate-policies/).

Application Requirements

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in Graduate Admissions Policies (http://catalog.gmu.edu/admissions/graduate-policies/). For information specific to this accelerated master's program, see Application Requirements and Deadlines (https://cehd.gmu.edu/bachelors-accelerated-masters-program/).

Accelerated Option Requirements

Students complete the following courses in their senior year.

Senior

Fall Semester	Credits	Spring Semester	Credits
SEED 540	3	EDRD 619	3
SEED 573	3	SEED 673	3
	6		6

Total Credits 12

While undergraduate students, accelerated master's students are able to apply two of the courses listed above to both the bachelor's and

master's degrees. These courses are considered advanced standing for the MEd. A minimum grade of B must be earned to be eligible to count as advanced standing. The other two courses are taken as reserve graduate credit and do not apply to the undergraduate degree. Early in their final undergraduate semester, students must submit the Bachelor's/Accelerated Master's Transition Form to the CEHD Admissions Office and specify which of the four courses are to be designated as advanced standing and reserve graduate credit.

Physics, BS/Applied and Engineering Physics, Accelerated MS

Overview

This program allows academically strong undergraduates with a demonstrable commitment to research to obtain the Physics, BS and Applied and Engineering Physics, MS (http://catalog.gmu.edu/colleges-schools/science/physics-astronomy/applied-engineering-physics-ms/) degrees by successfully completing 144 credits. Upon completion, students are well-prepared for entry into a professional school or a PhD program in physics or a related discipline.

Admitted students take selected graduate courses during their senior year and are able to use up to 6 graduate credits in partial satisfaction of requirements for the undergraduate degree. Upon completion and conferral of the bachelor's degree and with satisfactory performance (grade of 'B' or better) in each of the graduate courses, students are given advanced standing in the master's program and complete an additional 24 credits to receive the master's degree.

For more detailed information, see AP.6.7 Bachelor's/Accelerated Master's Degrees (http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7). For policies governing all graduate degrees, see AP.6 Graduate Policies (http://catalog.gmu.edu/policies/academic/graduate-policies/).

Application Requirements

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in the Graduate Admission Policies (http://catalog.gmu.edu/admissions/graduate-policies/) section of this catalog.

Successful applicants will have completed at least 90 credits toward their undergraduate degree and 45 credits in physics major coursework. The physics major GPA must be at least 3.50. One or more recommendation letters from one or more research supervisors are also required. Interested applicants should submit a letter to the undergraduate physics coordinator requesting admission along with the aforementioned recommendation letter(s). Contact the physics undergraduate or graduate coordinator for further details.

Accelerated Option Requirements

At the beginning of the student's final undergraduate semester, students must submit a bachelor's/accelerated master's transition form (http://registrar.gmu.edu/forms/) to the College of Science's Office of Academic and Student Affairs (https://cos.gmu.edu/about/contact-us/). Students must begin their master's program in the semester immediately following conferral of the bachelor's degree.

Students must maintain an overall GPA of 3.00 or higher in graduate coursework.

Reserve Graduate Credit

While still in undergraduate status, a maximum of 6 additional graduate credits may be taken as reserve graduate credit and applied to the master's program. Reserve graduate credits do not apply to the undergraduate degree.

Bachelor's Degree (selected), Bioinformatics Management, Accelerated PSM

Overview

This degree option allows highly qualified George Mason University bachelor's students to earn a Bioinformatics Management, PSM (https://catalog.gmu.edu/colleges-schools/science/systems-biology/bioinformatics-management-professional-science-masters/) degree in less time than if they had first graduated with a BS degree and then applied to the PSM program sequentially.

Admission and Processing Requirements

Students in the Biology, BS (https://catalog.gmu.edu/colleges-schools/ science/biology/biology-bs/); Chemistry, BS (https://catalog.gmu.edu/ colleges-schools/science/chemistry-biochemistry/chemistry-bs/); Computational and Data Sciences, BS (https://catalog.gmu.edu/collegesschools/science/computational-data-sciences/computational-datasciences-bs/); Neuroscience, BS (https://catalog.gmu.edu/collegesschools/science/neuroscience-program/neuroscience-bs/); or Physics, BS (https://catalog.gmu.edu/colleges-schools/science/physicsastronomy/physics-bs/) with an overall GPA of at least 3.00 in their last 60 credits are welcome to apply to the Bioinformatics Management, PSM (http://catalog.gmu.edu/colleges-schools/science/systems-biology/ bioinformatics-management-professional-science-masters/) accelerated master's program. Applicants to this accelerated master's should have previously taken courses in molecular biology, computer science, calculus, physical chemistry, and statistics. Students with deficiencies in one or more of these areas may be required to take additional courses from the undergraduate curriculum.

The GRE requirement is waived for students accepted into this accelerated program.

By the beginning of the undergraduate student's senior year, they should submit a Graduate Application for Accelerated Master's Program form (obtained from the College of Science's Office of Academic and Student Affairs (https://cos.gmu.edu/about/contact-us/)).

By at least the beginning of their senior year, students should seek out the Bioinformatics Management, PSM (https://catalog.gmu.edu/colleges-schools/science/systems-biology/bioinformatics-management-professional-science-masters/) Program Director who will aid the student in choosing the appropriate graduate courses to take and help to prepare the student for graduate studies.

In their senior year, accelerated master's students must complete the two graduate courses indicated on their Accelerated Master's Program Application with a minimum grade of 3.00 in each course. They must maintain a minimum GPA of 3.00 in all coursework and in coursework applied to their major. In the semester specified on the application (around the completion and conferral of the undergraduate degree), students must submit the Bachelor's/Accelerated Master's Transition form (found on the Office of the University Registrar website (http://

registrar.gmu.edu/forms/)) and will subsequently be admitted into graduate status.

Reserve Graduate Credits

Students admitted to this program may take graduate courses after completing 90 undergraduate credits, and up to 6 credits of appropriate graduate coursework may be used in partial satisfaction of the requirements for the undergraduate degree. If students earn at least a 3.00 GPA in these classes, they are granted advanced standing in the master's program and must then complete an additional 25 credits to receive the master's degree.

To apply these credits to the master's degree, students must request that the credits be moved from the undergraduate degree to the graduate degree using the Bachelor's/Accelerated Master's Transition form found on the Office of the University Registrar website (http://registrar.gmu.edu/forms/) (as noted above).

Students may take up to 6 additional approved graduate credits as reserve graduate credit. These credits do not apply to the undergraduate degree but will reduce the subsequent master's degree credits accordingly (e.g., with 6 credits counted towards undergraduate degree plus the maximum 6 reserve credits, the PSM could be completed with 19 post-bachelor's credits). The ability to take courses for reserve graduate credit is available to all high achieving undergraduates with the permission of the School of Systems Biology (https://catalog.gmu.edu/colleges-schools/science/systems-biology/).

Policies

For more detailed information on accelerated master's in general, see AP.6.7 Bachelor's/Accelerated Master's Degrees (https://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7).

For policies governing all graduate programs, see AP.6 Graduate Policies (https://catalog.gmu.edu/policies/academic/graduate-policies/).