

Program Approval Form

For approval of new programs and deletions or modifications to an existing program.

Action Requested: Create New (SCHEV approval red Inactivate Existing X Modify Existing (check <u>ALL</u> that a Title (SCHEV approval Concentration (Choos X Degree Requirements Admission Standards/ Other Changes: College/School: Submitted by: Effective Term: College / School	quired except for minors) apply) required except for minors) se one): Add Add Delete Application Requirements Science Please note: For studee 2018 must be fully energy of	Type (Change in the second stress of the	eck one): B.S. Minor rr's rgraduate Certificate* uate Certificate* elor's/Accelerated Master's Other: stronomy Email: paso@gmu.edu the University Cetalog	
	nt if necessary)			
See attached	nt ir necessary)			
Program Title: (Required) Title must identify subject matter. Do not includ name of college/school/dept. Concentration(s):	Existing Applied and Engineering Phy le	sics, MS	New/Modified	
Admissions Standards / Application Requirements: (Required only if different from those listed in the University Catalog)	on			
Degree Requirements: Consult University Catalog for models, attach separate document if necessary using track changes for modifications	See attached	See attached		
Courses offered via distance: (if applicable)				
TOTAL CREDITS REQUIRED:				
*For Certificates Only: Indicate whether students are able to pursue on a Full-time basis Part-time basis Approval Signatures				
Department	Date College/School	Date Provo	ost's Office Date ed for Minors and Interdisciplinary Programs	
If this program may impact another unit or is in collaboration with another unit at Mason, the originating department must circulate this proposal for review by those units and obtain the necessary signatures prior to submission. Failure to do so will delay action on this proposal.				
Unit Name	Unit Approval Name	Unit Approver's Signature	Date	
For Undergraduate Programs only				
Undergraduate Council Member	Provost Office)	Undergraduate Council Approval Date	
For Graduate Program	ns Only			
Graduate Council Member	Provost Office	9	Graduate Council Approval Date	
For Registrar Office's Use Only: Re	ceivedBanner	Catalog	revised 9/2/2016	

Program Proposal Submitted to the College of Science Curriculum Committee (COSCC)

The form above is processed by the Office of the University Registrar. This second page is for the COSCC's reference. Please complete the applicable portions of this page to clearly communicate what the form above is requesting.

FOR ALL PROGRAMS (required)

Program Title: Applied and Engineering Physics, MS

Date of Departmental Approval:

Modification was approved by the Department of Physics & Astronomy faculty on October 6, 2017.

FOR MODIFIED PROGRAMS (required if modifying a program)

Summary of the Modification:

- Add statement indicating what career goals each emphasis is for meeting.
- Make clear that elective requirements are in two categories (1) Emphasis Electives and (2)
 General Electives. Each require 9 credits.
- Replace lists of Emphasis Elective courses with lists of allowed course prefixes.
- Require a program of study in which student works with academic advisor to select a cohesive set of Emphasis Elective courses. (Registrar uses program of study for degree audit.)

No changes have been made to core course requirements.

Text before Modification (title, degree requirements, etc.):

Degree Requirements

Total credits: 30

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

Emphasis Requirement

Standard Emphasis

This emphasis is intended for students who may wish to pursue further graduate study in physics leading to a PhD degree in preparation for a career in basic research.

Code	Title	Credits
<u>PHYS 684</u>	Quantum Mechanics I	3

Code	Title	Credits
<u>PHYS 685</u>	Classical Electrodynamics I	3
<u>PHYS 705</u>	Classical Mechanics	3
<u>PHYS 711</u>	Statistical Mechanics	3
Select 9 cred	its from the following:	9
<u>ASTR 532</u>	Phys Interplanetary Med	
<u>ASTR 602</u>	Methods of Observational Astronomy	
<u>ASTR 603</u>	Planetary Sciences	
<u>ASTR 604</u>	Galaxies and Cosmology	
<u>ASTR 660</u>	Plasma Physics for Space and Astrophysics	
<u>ASTR 680</u>	Physics of Interstellar Media	
<u>ASTR 730</u>	Stellar Astrophysics	
<u>ASTR 764</u>	Computational Astrophysics	

ASTR 765 High-Energy and Accretion Astrophysics

Code	Title	Credits
<u>ASTR 790</u>	Topics in Astronomy and Astrophysics	
<u>PHYS 510</u>	Computational Physics I	
<u>PHYS 512</u>	Solid State Physics and Applications	
<u>PHYS 533</u>	Modern Instrumentation	
<u>PHYS 540</u>	Nuclear and Particle Physics	
<u>PHYS 575</u>	Atmospheric Physics I	
<u>PHYS 611</u>	Electro-optics	
<u>PHYS 612</u>	Physics of Modern Imaging	
<u>PHYS 613</u>	Computational Physics II	
<u>PHYS 614</u>	Thermodynamics and Kinetics of Materials	
<u>PHYS 615</u>	Fundamentals of Materials Science	
<u>PHYS 620</u>	Continuum Mechanics	
<u>PHYS 628</u>	Relativity	

Code	Title	Credits
<u>PHYS 630</u>	Introduction to Biophysics	
<u>PHYS 660</u>	Space Weather	
<u>PHYS 684</u>	Quantum Mechanics I	
<u>PHYS 685</u>	Classical Electrodynamics I	
<u>PHYS 701</u>	Theoretical Physics	
<u>PHYS 736</u>	Computational Quantum Mechanics	
<u>PHYS 760</u>	Space Plasma Physics	
<u>PHYS 780</u>	Advanced Selected Topics in Physics	
<u>PHYS 784</u>	Quantum Mechanics II	
<u>PHYS 785</u>	Classical Electrodynamics II	
<u>CSI 720</u>	Fluid Mechanics	
<u>CSI 721</u>	Computational Fluid Dynamics I	
<u>CSI 722</u>	Computational Fluid Dynamics II	

Code	Title	Credits
<u>CSI 786</u>	Molecular Dynamics Modeling	
<u>CSI 787</u>	Computational Materials Science	
<u>CSI 788</u>	Simulation of Large Scale Systems	

Total Credits

21

Course List

Engineering Physics Emphasis

This emphasis allows students to select a larger number of courses from electrical engineering and other areas.

Code	Title	Credits
Choose one of the following:		3
<u>PHYS 684</u>	Quantum Mechanics I	
<u>PHYS 502</u>	Introduction to Quantum Mechanics and Atomic Physics	
<u>PHYS 690</u>	Engineering Thermodynamics	
Choose one of the following:		3
Choose one of the following:		3

Code	Title	Credits
<u>PHYS 513</u>	Applied Electromagnetic Theory	
<u>PHYS 620</u>	Continuum Mechanics	
<u>PHYS 510</u>	Computational Physics I	3
<u>PHYS 533</u>	Modern Instrumentation	3
or <u>PHYS 613</u>	Computational Physics II	
Select 9 credits of	graduate-level PHYS, ECE, CEIE, or MATH courses ¹	9

Total Credits

Course List

¹ Advisor approval required

Applied Physics Emphasis

This emphasis is intended for those who wish to apply the techniques and subject areas of physics to multifaceted problems encountered in the workplace, particularly in physics, engineering, computational science, and other related areas.

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Code	Title	Credits
<u>PHYS 510</u>	Computational Physics I	3
<u>PHYS 533</u>	Modern Instrumentation	3

Code	Title	Credits
<u>PHYS 684</u>	Quantum Mechanics I	3
or <u>PHYS 502</u>	Introduction to Quantum Mechanics and Atomic Physics	
<u>PHYS 685</u>	Classical Electrodynamics I	3
or <u>PHYS 513</u>	Applied Electromagnetic Theory	
Select 9 credits fro	m the following:	9
<u>PHYS 581</u>	Topics in Renewable Energy	
<u>BINF 731</u>	Protein Structure Analysis	
<u>BINF 741</u>	Introduction to Computer Simulations of Biomolecules	
<u>CLIM 710</u>	Introduction to Physical Climate System	
<u>CLIM 711</u>	Introduction to Atmospheric Dynamics	
<u>CLIM 712</u>	Physical and Dynamical Oceanography	
<u>CLIM 713</u>	Atmosphere-Ocean Interactions	
<u>CLIM 714</u>	Land-Climate Interactions	
<u>CLIM 715</u>	Numerical Methods for Climate Modeling	

Code	Title	Credits
<u>CLIM 750</u>	Geophysical Fluid Dynamics	
<u>CSI 742</u>	The Mathematics of the Finite Element Method	
<u>CSI 763</u>	Statistical Methods in Space Sciences	
<u>CSI 782</u>	Statistical Mechanics for Modeling and Simulation	
<u>CSI 783</u>	Computational Quantum Mechanics	
<u>ECE 521</u>	Modern Systems Theory	
<u>ECE 528</u>	Introduction to Random Processes in Electrical and Computer Engineering	
<u>ECE 548</u>	Sequential Machine Theory	
<u>ECE 565</u>	Introduction to Optical Electronics	
<u>ECE 584</u>	Semiconductor Device Fundamentals	
<u>ECE 699</u>	Advanced Topics in Electrical and Computer Engineering	

Or any course listed in the Standard Emphasis

Total Credits

Code	Title	Credits
Select nine elective	credits from the following: 1	9
<u>PHYS</u>		
<u>CHEM</u>		
MATH		
ECE		
<u>CSI</u>		
<u>PHYS 798</u>	Research Project	
<u>PHYS 799</u>	Master's Thesis	
<u>ECE 798</u>	Research Project	
<u>ECE 799</u>	Master's Thesis	

Total Credits

9

Course List

¹ No more than 6 credits may be chosen from areas outside ASTR, CSI, ECE, NANO, and PHYS.

Notes:

• Students may choose to take either <u>PHYS 798</u> Research Project/<u>ECE 798</u> Research Project or <u>PHYS 799</u> Master's Thesis/<u>ECE 799</u> Master's Thesis (6 credits), but not both. The research project may be conducted at a student's place of employment with the concurrence of a faculty advisor.

- The thesis is a more substantial piece of work performed under the supervision of a faculty member and requires students to make an oral defense. <u>PHYS 798</u> Research Project/<u>ECE 798</u> Research Project may be taken only once. No more than 6 credits of <u>PHYS 799</u> Master's Thesis may be applied to the degree.
- Students in the master's degree program can earn the <u>Data Science Graduate Certificate</u> from the <u>Department of Computational and Data Sciences</u> by choosing an approved sequence of courses.

Text after Modification (title, degree requirements, etc.):

Degree Requirements

Total credits: 30

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

Plan of Study

Before the end of their first semester, each student must submit to the graduate coordinator's office a plan of study that has been approved by their academic advisor. The selected courses must be cohesive and lead to comprehensive knowledge in one area; it cannot be a set of disjointed courses.

Any deviations from this plan must be approved by the student's academic advisor. A final, signed version of the plan must be submitted to the graduate coordinator at the start of the semester in which the student plans to graduate.

Standard Emphasis

This emphasis is intended for students who may wish to pursue further graduate study in physics or astrophysics or pursue graduate study following the Standard Physics concentration of the Physics PhD.

(12) Core Courses: PHYS 684, 685, 705, 711

- (9) Emphasis Electives^(a): Graduate-level ASTR and PHYS courses
- (9) General Electives^(b): Graduate-level science courses approved by an academic advisor.

Total: 30

Engineering Physics Emphasis

This emphasis is intended for students who may wish to pursue employment in an engineering-related field or pursue graduate study following the Engineering Physics concentration of the Physics PhD.

(12) Core Courses: One from each group: {510}, {502,684,690}, {513,685,620}, {533,613}
 (9) Emphasis Electives^(a): Graduate-level BENG/CEIE/ECE/MATH/ME/PHYS courses
 (9) General Electives^(b): Graduate-level science and engineering courses approved by an academic advisor.

Total: 30

Applied Physics Emphasis

This emphasis is intended for students who may wish to pursue employment in an applied physics or engineering related field.

(12) Core Courses: One from each group: {510}, {533}, {502,684}, {513,685}

(9) Emphasis Electives^(a): Graduate-level BINF/CHEM/CLIM/CSI/MATH/STAT/PHYS courses

(9) General Electives^(b): Graduate-level science and engineering courses approved by an academic advisor.

Total: 30

(a) These must be regular courses and not directed reading, research, or thesis credits.

(b) Students may take PHYS 796 (Directed Reading and Research) and up to 6 credits of PHYS 798 (Research Project) as general electives. PHYS 798 is conducted under the supervision of a faculty research advisor and may be based on work done as an intern. Up to 6 credits of PHYS 799 (Master's Thesis) may be taken as general electives by students pursuing the thesis option and may also be based on work done as an intern.

Thesis Option

In preparation for this option, the student must form a committee comprising a chair and two other faculty members.

The student completes a thesis under the direction of the committee chair. The thesis work is typically completed while students are registered for 6 credits of PHYS 799 MS Thesis. A thesis proposal and thesis are submitted in accordance with <u>AP.6 Graduate Policies</u>. The student must give an oral defense of the thesis to the committee and the George Mason community at large. Students are expected to respond to questions on the thesis and related material. The committee determines whether the defense is satisfactory.

Reason for the Modification:

The department would like to change the explicit lengthy list of often outdated courses in our MS Emphases requirements to a much more streamlined listing in terms of prefixes. We plan to control and manage the degree auditing process with an explicit Program of Study form for each student in consultation with and to be approved by the student's academic advisor.