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Viewing: SC-MS-PHAE : Applied and Engineering Physics, MS

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Changes proposed by: jbazaz

Catalog Pages Using this Program

Applied and Engineering Physics, MS

Are you completing this form on someone else's behalf?

Yes

Requestor:

Name	Extension	Email
Jessica Rosenberg	9551	jrosenb4

Effective Catalog: 2020-2021

Program Level: Graduate

Program Type: Master's

Degree Type: Master of Science

Title: Applied and Engineering Physics, MS

Banner Title: **Applied & Engineering Phys MS**

Registrar/OAPI Use Only – SCHEV Status Approved

Registrar's Office Use Only – Program Start Term

Registrar/OAPI Use Only – SCHEV Letter

Concentration(s):

In Workflow

1. **PHYS GR Committee**
2. PHYS Chair
3. SC Curriculum Committee
4. SC Associate Dean
5. SC CAT Editor
6. Assoc Provost-Graduate
7. Registrar:Concentrat Code
8. Registrar-Programs: Duration
9. Registrar-Programs

History

1. Nov 14, 2017 by clmig-jwehrheim
2. Jan 16, 2018 by Rebekah Zacharias (rzachari)
3. Mar 6, 2018 by Jennifer Bazaz Gettys (jbazaz)
4. Mar 6, 2018 by pchampan
5. Mar 14, 2018 by Rebekah Zacharias (rzachari)

6. Mar 28, 2018 by Rebekah Zacharias (rzachari)
7. Mar 29, 2018 by Rebekah Zacharias (rzachari)

	Associated Concentrations	Registrar's Office Use Only: Concentration Code
1	Quantum Information Science and Engineering Concentration	

Registrar/IRR Use Only – Concentration CIP Code

College/School: College of Science

Department / Academic Unit: Physics & Astronomy

Jointly Owned Program? No

Justification

The objective of this new concentration is to create a graduate program of study in quantum information science and engineering (QISE) that works alongside industrial partners. The National Quantum Initiative, signed into law in December 2018, mandated the creation of new research and educational programs to support the second quantum technological revolution. By harnessing quantum phenomena, it is possible to radically improve computing, sensing, and communications technology.

Presently, there is a massive shortage of scientists and engineers with the appropriate expertise in quantum experiment and quantum theory. Numerous established companies and young technology startups are actively seeking highly trained Masters-level employees who can help make advances in quantum technologies. Through consultations with companies such as Northrop Grumman, Lockheed Martin, Qrypt, and Montana Instruments, as well as the Quantum Materials Center's participation in a workforce needs surveys with the Quantum Economic Development Consortium, four key focus areas have been identified that constitute key needs in the quantum community. To achieve these goals and readily transition the

transdisciplinary masters' students to employment in the quantum workforce, we have designed a flexible curriculum that has industrial interaction at its core and can adapt as the industry more clearly defines what is needed in this new area.

Total Credits Required: Total credits: 30

Registrar's Office Use Only - Program Code:

SC-MS-PHAE

Registrar/IRR Use Only – Program CIP Code

Admission Requirements:

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.
Individuals holding a baccalaureate degree in physics or a related field from a regionally accredited institution and who have earned a GPA of 3.00 (out of 4.00) in their last 60 credits are invited to apply for admission. ~~If the baccalaureate degree is in a field other than physics, applicants should have taken several courses beyond the introductory physics courses, such as junior-level classical mechanics, electricity and magnetism, or electronics.~~Applicants may be required to make up one or two deficiencies, based on a graduate physics advisor's assessment, and be provisionally admitted into the program. Three letters of recommendation must be submitted, preferably from former professors. The general GRE and the GRE subject test in physics are recommended for applicants who received their baccalaureate degrees within the past five years.

Program-Specific Policies:

Policies

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

Degree Requirements:

Students should refer to the Admissions & Policies tab for specific policies related to this program. Select one emphasis and complete all the requirements therein.

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.

Select one emphasis and complete all the requirements therein.

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.

Course List

Code	Title	Credits
Core Courses		12
PHYS 684	Quantum Mechanics I	
PHYS 685	Classical Electrodynamics I	
PHYS 705	Classical Mechanics	
PHYS 711	Statistical Mechanics	
Emphasis Electives [1]		
Select 9 credits of graduate-level courses from the following:		9
ASTR		
PHYS		
General Electives [2]		9
Select 9 credits of graduate-level science courses approved by an academic advisor.		
Total Credits		30

1 These must be regular courses and not directed reading, research, or thesis credits.

2 Students may take PHYS 796 Directed Reading and Research and up to 6 credits of PHYS 798 Research Project as general electives. PHYS 798 Research Project 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.

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.

Course List

Code	Title	Credits

Code	Title	Credits
Core Courses		12
Choose one course from each group:		
Group One		
PHYS 510	Computational Physics I	
Group Two		
PHYS 502	Introduction to Quantum Mechanics and Atomic Physics	
PHYS 684	Quantum Mechanics I	
PHYS 690	Engineering Thermodynamics	
Group Three		
PHYS 513	Applied Electromagnetic Theory	
PHYS 620	Continuum Mechanics	
PHYS 685	Classical Electrodynamics I	
Group Four		
PHYS 533	Modern Instrumentation	
PHYS 613	Computational Physics II	
Emphasis Electives [1]		9
Select 9 credits of graduate-level courses from the following:		
BENG		
CEIE		
ECE		
MATH		
ME		
PHYS		
General Electives [2]		9
Select 9 credits of graduate-level science and engineering courses approved by an academic advisor.		
Total Credits		30

1 These must be regular courses and not directed reading, research, or thesis credits.

2 Students may take PHYS 796 Directed Reading and Research and up to 6 credits of PHYS 798 Research Project as general electives. PHYS 798 Research Project 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.

Applied Physics Emphasis

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

Course List

Code	Title	Credits
Core Courses		12
Select one course from each group:		
Group One		
PHYS 510	Computational Physics I	
Group Two		
PHYS 533	Modern Instrumentation	
Group Three		
PHYS 502	Introduction to Quantum Mechanics and Atomic Physics	
PHYS 684	Quantum Mechanics I	
Group Four		
PHYS 513	Applied Electromagnetic Theory	
PHYS 685	Classical Electrodynamics I	
Emphasis Electives		9
Select 9 credits of graduate-level courses from the following:		
BINF		
CHEM		
CLIM		
CSI		
MATH		
STAT		
PHYS		
General Electives 2		9
Select 9 credits of graduate-level science and engineering courses approved by an academic advisor.		
Total Credits		30

1 These must be regular courses and not directed reading, research, or thesis credits.

2 Students may take PHYS 796 Directed Reading and Research and up to 6 credits of PHYS 798 Research Project as general electives. PHYS 798 Research Project 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.

Quantum Information Science and Engineering Concentration

This concentration prepares students for the quantum information workforce through study of physics and courses across mathematics, computer science, electrical engineering, and mechanical engineering as appropriate for their career plans in this multidisciplinary field.

Course List

Code	Title	Credits
Core Courses		
PHYS 534	**Introduction to Quantum Computation and Quantum Information**	**3**
PHYS 591	**Systems for Quantum Scientists**	**3**
PHYS 711	**Statistical Mechanics**	**3**
Select one course from each group:		
Group One		**3**
PHYS 502	**Introduction to Quantum Mechanics and Atomic Physics**	
PHYS 684	**Quantum Mechanics I**	
Group Two		**3**
PHYS 513	**Applied Electromagnetic Theory**	
PHYS 685	**Classical Electrodynamics I**	
Electives		
Choose one from the following:		**3**
PHYS 512	**Solid State Physics and Applications**	
PHYS 533	**Modern Instrumentation**	
PHYS 611	**Electro-optics**	
PHYS 690	**Engineering Thermodynamics**	
PHYS 736	**Computational Quantum Mechanics**	
PHYS 784	**Quantum Mechanics II**	
CS 583	**Analysis of Algorithms**	
CS 587	**Introduction to Cryptography**	
CS 630	**Advanced Algorithms**	
ECE 646	**Applied Cryptography**	
ECE 685	**Nanoelectronics**	
ECE 746	**Advanced Applied Cryptography**	
ECE 747	**Cryptographic Engineering**	
Select 9 credits of graduate-level science and engineering courses approved by an academic advisor. 1		**9**
Research Project		
PHYS 798	**Research Project**	**3**
Total Credits		30

1Students may take PHYS 796 Directed Reading and Research and up to 6 credits of PHYS 798 Research Project as general electives. PHYS 798 Research Project 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 who would like a thesis option in addition to the research project.

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 Master's Thesis. A thesis proposal and thesis are submitted in accordance with AP.6 Graduate Policies. 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.

Retroactive Requirements Updates:

Plan of Study:

Additional Program Information

This information is required by the Office of Accreditation and Program Integrity.

Courses offered via distance (if applicable):

What is the primary delivery format for the program?
Face-to-Face Only

Does any portion of this program occur off-campus?
No

Are you working with a vendor / other collaborators to offer your program?
No

Related Departments

Could this program prepare students for any type of professional licensure, in Virginia or elsewhere?
No

Are you adding or removing a licensure component?

No

Additional SCHEV & SACSCOC Information

Are you changing the total number of credits required for this program?

No

Are you changing the delivery format in any way (e.g adding an online option)?

No

Are you adding/removing a licensure option which was approved by SCHEV?

No

Will any portion of this program be offered at an off-campus location?

No

Are you adding significant new content areas to the program?

No

Will this program change affect any specialized accreditation?

No

Green Leaf Program Designation

Is this a Green Leaf program?	No

Does this program cover material which crosses into another department?

No

Additional Attachments	msphae_001.pdf
SCHEV Proposal	
Executive Summary	
Reviewer Comments	
Additional Comments	

Is this course required of all students in this degree program?

%wi_required.eschtml%

Key: 347