

UNIVERSITY OF MARY WASHINGTON – PROGRAM CHANGE PROPOSAL

Electronically submit this completed form with attachments in one file to the Chair of the College Curriculum Committee.

COLLEGE (check one):	Arts and Sciences <input checked="" type="checkbox"/>	X	Business <input type="checkbox"/>	Education <input type="checkbox"/>
Proposal Submitted By: Charles Sharpless & Hai Ngyuen			Date Prepared: 9/5/18	
Department /Program:	PHYSICS			

1. *Note: for any program change entailing the addition any new courses, or revisions to existing courses, separate proposal for those course actions must also be submitted. If the proposal involves changes in course credit hours as a part of the program change, "Change_Course_Credits" proposal forms for each course with revised credit hours must also be submitted.*

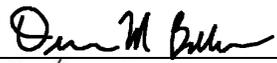
PROPOSAL TO CHANGE EXISTING PROGRAM (check no than one of the following).	
Revise requirements for existing major	<input type="checkbox"/>
Revise requirements for a concentration within an existing major	<input type="checkbox"/>
Revise requirements for an existing degree program	<input type="checkbox"/>
Revise requirements for existing certificate program	<input type="checkbox"/>
Revise requirements for existing minor	<input type="checkbox"/>
Implementation Date: FALL semester, year:	<input type="text"/>

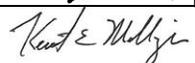
PROPOSAL TO CREATE NEW PROGRAM NOT REQUIRING STATE ACTION	
(check no more that one of the following)	
New concentration within existing major	<input checked="" type="checkbox"/> Name: Applied Physics
New minor	<input type="checkbox"/> Name:
New Major but NOT a new degree*	<input type="checkbox"/> Name:
<small>*Use ONLY for interdisciplinary majors that will be grouped as part of the "Special Majors/General Liberal Arts and Sciences" degree (CIP Code 24.0101) or reported as a BLS degree (CIP Code 24.0199)</small>	
Implementation Date (semester and year):	Fall 2019

REQUIRED ATTACHMENTS FOR ALL PROPOSALS FOR PROGRAM CHANGE OR FOR NEW PROGRAMS NOT REQUIRING STATE APPROVAL:

2. **Rationale statement** (Why is this additional program needed? What purposes will it serve?)
3. **Impact Statement** (Provide details about the Library, space, budget, technology, and impacts created by this program change. Supporting statements from the Library, IT Department, etc. evaluating the resource impact and feasibility of adding the new program are required.) *If the proposal involves changes in course credit hours as a part of the program change, "Change_Course_Credits" proposal forms for each course with revised credit hours must also be submitted.*
4. **Catalog Copy** (Provide the complete Catalog Description for the proposed new program)
5. **Any change that impacts another Department must have a written statement (such as a copy of an email) from the Chair(s) agreeing to the change.**

Department Chair Approval*: Charles Sharpless Date: 9/5/18

CCC Chair Approval:  Date: 9/24/2018

Dean Approval:  Date: 9/24/18

*COB and COE proposals approved by the Associate Dean.

BEFORE consideration by the UCC, the proposal must be approved the three levels noted above. Approval by the UCC, UFC, and Provost** are noted on the proposal "status history" at the UCC web site.

**Provost approval is required in cases of proposals for new concentrations, new minors, new majors that do not involve a new degree, *or program changes involving changes to credit hours of courses in the program's requirements.*

REQUIRED ATTACHMENTS

Rationale statement (Why is this additional program needed? What purposes will it serve?)

UMW's Physics Department knows that the traditional liberal education serves students exceedingly well. It provides a strong foundation for students who wish to become major contributors to society and the economy. A strong emphasis in science with a liberal art foundation helps catalyze the process of producing accomplishments and results. Still, pieces of our curriculum could serve a wider audience through a more applied focus.

During the resource reallocation process several years ago, it was suggested that the physics department could be well served by expanding their program to include a major in Engineering Physics. Later, the Physics Department completed their 10-year review during the fall semester of 2015, and the external reviewing team studied our program and provided a written report sharing their expertise and insights. It was suggested that because other schools in the commonwealth and around the nation have had great successes serving students who are not going directly into graduate schools that we too consider a track (or major) with a more applied slant. This proposal is, at least in part, a response to these two suggestions.

About 75% of UMW's physics alumni from the classes of 2013 and 2014 are now employed in the private sector, working in a STEM-related position and, in particular, 59% of those are employed in an Engineering, Computer, or Information Systems area. The most valuable skills in such a private sector position center around the ability to solve technical problems, a skill most easily developed through a more hands-on, applied approach in a physics curriculum.

It is important to note the need to continue our traditional curriculum and add the applied physics major on top of this. Our traditional physics majors has a strong track record of preparing students for advanced study in graduate programs in physics, education, and engineering. Indeed, our program tends to graduate more majors than what would be expected for a department of our size. We certainly do not want to disrupt the success we have had in this area. Rather, we are looking to better serve the needs of students *not* interested in advanced study. Such students would be well-served with the experimental and quantitative approach embedded in this new curriculum.

While many schools have developed a curriculum in "engineering physics" in order to meet the demands described above, our careful analysis of existing programs at schools similar to UMW shows that such a move would require us to develop several new courses specifically in engineering, something that we just do not have the resources for at this time. However, a close examination of the "applied physics" curriculum at competitor schools shows that we could painlessly develop such a program here at UMW by leveraging our strong partner programs in mathematics and computer science. Our approach is to combine the applied and experimental courses in the physics curriculum with applied mathematics and data science. This will provide students with a solid experimental background and the quantitative skills to analyze data and work with mathematical tools used to model the physical world. The curriculum is rigorous, with a core set of 26 required credits. Electives in physics and mathematics will allow students to tailor their program to their interests. A required capstone, designed to satisfy the experiential learning requirement of general education, will give students the practical experience to move seamlessly from college to career. The curriculum would be structured as follows (note that Type IV courses, a.k.a. hidden prerequisites, are in parentheses):

Required Core Courses (26 credits, Type IV courses in parentheses)

Physics (20)	Mathematics (Co-requisites for Physics 105-106)	Data Science (6)
PHYS 105 (4): University Physics with Lab I PHYS 106 (4): University Physics with Lab II PHYS 211 (3): Modern Physics PHYS 317 (3): Methods of Mathematical Physics PHYS 384 (4): Advanced Physics Laboratory PHYS 482 (2): Senior Seminar	(MATH 121 (4): Calculus I) (MATH 122 (4): Calculus II)	(DATA 101 (3): Introduction to Data Science) DATA 219 (3): Foundations of Data Science CPSC 420 (3): Modeling & Simulation

Additional Electives (10-12 credits)

Physics <i>at least 2 additional courses (7-8 credits)</i>	Mathematics <i>at least 1 additional courses (3-4 credits)</i>
PHYS 201: Thermodynamics and Statistical Mechanics (3) PHYS 283: Electronics with Lab (4) PHYS 292: Optics with Lab (4) PHYS 320: Classical Mechanics with Lab (4) PHYS 330: Electricity and Magnetism with Lab (4)	MATH 224 (4): Multivariable Calculus MATH 300 (3): Linear Algebra MATH 312 (3): Differential Equations MATH 351 (3): Numerical Analysis I MATH 325 (3): Discrete Mathematics MATH 411 (3): Chaotic Dynamical Systems

Capstone requirement (1-3 credits)

Each student will be required to complete a capstone experiential learning requirement. This requirement could be met with either of the following:

- PHYS 499: Internship with a local company or government agency working in an area of physics
- PHYS 491: Undergraduate research experience

TOTAL REQUIRED CREDITS: 37 to 41

The required capstone is a critical piece of the proposed curriculum. The interim dean and the physics department chair have already made efforts toward establishing partnerships with area businesses. Indeed, we have already received enthusiastic support from the president of the Fredericksburg Regional Alliance and scientists from Polaris Alpha, Dynovis, and the Naval Surface Warfare Center – Dahlgren, just to name a few. There is tremendous potential for building regional partnerships from a program such as this.

An example schedule for completing the required courses in the Applied Physics major is shown below, resulting in a maximum of 41 credits and a minimum of 37 credits. Type IV courses have their credits shown in parentheses.

<i>First Year</i>			
<i>Fall</i>	<i>Credits</i>	<i>Spring</i>	<i>Credits</i>
PHYS 105	4	PHYS 106	4
MATH 121	(4)	MATH 122	(4)
DATA 101	(3)	DATA 219	3
<i>Second Year</i>			
<i>Fall</i>	<i>Credits</i>	<i>Spring</i>	<i>Credits</i>
PHYS 211	3	CPSC 420	3
PHYS elective	3 or 4	MATH 224 (elective)	4
<i>Third Year</i>			
<i>Fall</i>	<i>Credits</i>	<i>Spring</i>	<i>Credits</i>
PHYS 317	3	PHYS elective	3 or 4
<i>Fourth Year</i>			
<i>Fall</i>	<i>Credits</i>	<i>Spring</i>	<i>Credits</i>
PHYS 491 or 499	1 to 3	PHYS 384	4
PHYS 482	2		

1. **Impact Statement** (Provide details about the Library, space, budget, technology, and impacts created by this program change. Supporting statements from the Library, IT Department, etc. evaluating the resource impact and feasibility of adding the new program are required.)

Naturally, our hope is that this more practical career-ready approach to physics will attract more students to the physics program. Core courses run regularly and we do not expect any significant change in offerings. Depending on enrollment trends, we may need to offer some physics elective courses on a more frequent rotation. Currently, these courses are offered every other year. The department will need to carefully monitor demand to meet the needs of the students, and it is likely that demands could be met with on modest adjunct requests. However, we should also point out that the physics program has been struggling to meet demands with only three full-time physics faculty. If the proposal program generates even modest student interest, it will certainly be necessary to reevaluate the need to increase the faculty back to four FTEs. It is only the past few years that the department has had only three FTEs and this has created many challenges for maintaining the health of our program.

It is worth noting the opportunity that a program such as this would provide given the addition to Jepson Science Center. Our new spaces would offer sufficient laboratories for collaborative learning environments and research projects for the students. Recent ETF requests have updated our optics equipment, the dean's office has assisted in upgrading our electronics kits, and a newly acquired license for Matlab (a scientific computing platform) has increased our abilities to provide the resources needed to execute a program in applied physics. Now is the time to capitalize on our resources and expand our program in this career-ready direction.

2. **Catalog Copy** (Provide the complete Catalog Description for the proposed new program)

Revisions/additions to the Catalog Description are underlined or struck through in red.

The Physics Program

The study of physics provides the basis for understanding the fundamental laws of the physical universe. The principles of physics underlie other natural sciences and are essential to many applied sciences and technical programs. The physics program's goal is to expose students to a broad range of physical phenomena. In doing so, the program strives to meet the needs of students who will become specialists in physics, as well as numerous related fields. A secondary aim is to satisfy the interest of students who take physics to fulfill a general education requirement.

The Physics Department offers two major tracks towards a Bachelor of Science degree, Physics, and Applied Physics. Senior majors in either track may participate in undergraduate research, which could qualify as an honor thesis and/or result in a presentation at a local or national conference. The Society of Physics Students and its honorary society, Sigma Pi Sigma, have sponsored guest speakers and field trips to national laboratories and conferences. ~~Physics is a Bachelor of Science degree program for students interested in challenging, exciting, and productive careers in fields such as: acoustics, astronomy, astrophysics, atomic physics, biophysics, chemical physics, fluid dynamics, geophysics, low-temperature physics, medical physics, materials science, nuclear physics, optics, particle physics, physics education, plasma physics, solid state physics, spectroscopy and vacuum physics. Graduates have gone on to successful careers as researchers, educators, engineers, etc.~~

The Physics track is a ~~Bachelor of Science~~ degree program for students interested in challenging, exciting, and productive careers in fields such as: acoustics, astronomy, astrophysics, atomic physics, biophysics, chemical physics, fluid dynamics, geophysics, low-temperature physics, medical physics, materials science, nuclear physics, optics, particle physics, physics education, plasma physics, solid state physics, spectroscopy and vacuum physics. Graduates have gone on to successful careers as researchers, educators, engineers, etc and many other technical fields.

The Applied Physics track is designed for students who have an interest and ability in the experimental and quantitative approaches to physics. This track provides a solid preparation for almost any technical career, because it teaches students how to analyze complex problems and it gives students a strong quantitative background that can be applied in any technical field. Applied Physics students work with the latest high-tech equipment and are prepared for in-demand careers in industry. UMW's curriculum reflects that practical approach, preparing students for a seamless transition from college to industry.

Credit for only one introductory physics sequence (101-102, 101-108, 103-104, 105-106 or 105-110) can be counted toward the degree requirement.

*Wording change by UCC for consistency & clarity in Catalog --
10-10-18.*

Requirements for the Physics Major Track

Forty-one (41) credits as follows: Thirty-two (32) credits from Physics 105, 106, 211, 317, 320, 330, 384, 410, and 482; at least nine (9) credits from Physics 201, 210, 283, 292, 471, and 472.

Requirements for the Applied Physics Track

Between thirty-seven (37) and forty-one (41) credits as follows: Twenty-six (26) credits from Physics 105, 106, 211, 317, 384, and 482; Data Science 219; and Computer Science 420. Seven or eight (7-8)

credits come from any combination of Physics 201, 283, 292, 320, or 330. Three to Four (3-4) additional credits come from any of Mathematics 224, 300, 312, 325, 351, or 411. The final credits, up to three (3), come from an approved capstone experience Physics 491 or 499.

4. **Any change that impacts another Department must have a written statement (such as a copy of an email) from the Chair(s) agreeing to the change.**

See attachments.

Evaluation Protocols for Physics 499

Internship in Applied Physics

General Expectations of All Interns

- Punctuality:
 - Arrive at internship promptly.
 - Finish work in a timely manner.

- Professionalism:
 - Dress appropriately.
 - Be courteous and respectful.
 - Work as a valued team member.
 - Engage in regular and effective communication with peers and supervisors throughout the course of the internship.

Intended Learning Outcomes

- Apply knowledge from core classes during internship project.
- Make sufficient progress on a project that is useful in a commercial/business application.
- Learn and apply new technical skills that are appropriate for the internship project (where applicable).
- Show initiative in offering possible solutions for the project.
- Show persistence in the advancement of the project.
- Work as an effective team member.
- Participate fully in the work environment, including normal work-related functions.
- Effectively communicate the progress or results of the internship project, either orally or in writing, just as any company employee would.

Types of projects

Design

Analysis

Troubleshoot

Construct/Build/Prototype

Test

Repair

**Physics 499 Internship
Evaluation Form (Completed by Industrial Supervisor)**

Name of student:

Location of internship:

Type of project (check all that apply):

Design ___ Analysis ___ Prototype/Build ___ Test ___ Repair ___
Other ___ Explain:

For the project, the intern most likely used knowledge from the following areas of physics (check all that apply):

___ Mechanics
___ Electric Circuits
___ Electricity and Magnetism
___ Statistical Mechanics
___ Computation
___ Experimental Physics

Please describe any new technical skills or knowledge that you feel the intern acquired during the industrial work experience:

The intern showed initiative in finding solutions and persistence in advancing the project:

Strongly Agree ___ Agree ___ Disagree ___ Strongly Disagree ___

Comments:

The intern worked well in a team environment:

Strongly Agree ___ Agree ___ Disagree ___ Strongly Disagree ___

Comments:

The intern was effective at communicating the progress of the project throughout the internship period:

Strongly Agree ___ Agree ___ Disagree ___ Strongly Disagree ___

Comments

Considering the constraints on time and resources, sufficient progress was made on the project:

Strongly Agree ____ Agree ____ Disagree ____ Strongly Disagree ____

Comments

Type of final report given: Written ____ Oral Presentation to Group ____

Informal Presentation ____ Other ____

Comments on final report (e.g. overall knowledge of project, knowledge of details, communication skills, progress, etc.):

Overall Evaluation

I was satisfied with the overall performance of the intern:

Strongly Agree ____ Agree ____ Disagree ____ Strongly Disagree ____

Comments:

Please answer the following questions to help the UMW Department of Physics to evaluate various aspects of the internship program.

What did you expect the intern to know that he/she did not know?

Was there something the intern knew that you did not expect him/her to know?

Were the times and days of the week that the intern worked acceptable or might they need to be modified.

In the administration of the internship, should the UMW representative change the number of visits made to the internship site or is the current number acceptable?

Are there other aspects of the internship experience that might need modification?

4/16/2018

Dr. Hai Nguyen
Chair, Department of Physics

Dr. Nguyen,

I received your request for a letter of support for the new Applied Physics program you are proposing. This letter outlines the kind of technical assistance IT Support Services can provide your proposed program.

IT Support Services staff will support computers installed in labs and classrooms in the Jepson Science Center. This includes regular maintenance of the computers and installation of software including Office, Visio, Project, Mathematica, and ArcGIS as requested.

Any additional software or peripherals necessary to support your program would be purchased by your department in consultation with ITSS staff, including maintenance agreements or other annual support costs. The department would also be responsible for replacement costs for any specialized equipment necessary for the program. We will install and work with the department to maintain UMW computers and software.

ITSS support staff will partner with Physics faculty, relying on their leadership and expertise to support specialized systems and software. Understand that ITSS staff will have no particular expertise with specialized equipment and software, and will provide "best-effort" support for those items.

Sincerely,

Jerry Slezak
Director, IT Support Services



where great minds get to work

TO: Hai Nguyen
Chair, Department of Physics

FROM: Randall D. Helmstutler
Chair, Department of Mathematics

A handwritten signature in black ink that reads "Randall D. Helmstutler".

DATE: 28 March 2018

RE: Applied Physics major proposal

The Department of Mathematics is in support of the current proposal for the new major in Applied Physics. The required or elective courses in MATH would impose no additional strain on our current offerings (in fact, it may enhance them). Moreover, given our current course rotations in the department, a student in this major should have plenty of freedom of choice in mapping out and acquiring any desired MATH electives: all MATH courses in the major are routinely offered. In summary, we are in favor of supporting Physics in this new major program.



DEPARTMENT OF COMPUTER SCIENCE

Trinkle Hall B22
1301 College Ave
Fredericksburg, VA 22401

April 5, 2018

Department of Computer Science
University of Mary Washington
1301 College Ave
Fredericksburg, VA 22401

To Whom it May Concern:

The UMW Computer Science Department would like to express our approval and support of the new "Applied Physics" major being proposed. We believe it is a solid program that will be attractive to UMW students, and that its demands on our own department will be modest enough not to cause undue concern.

Sincerely yours,

A handwritten signature in black ink that reads "Stephen Davies".

Stephen Davies, Ph.D.

Associate Professor and Chair, Computer Science
Program Director, Data Science program

UMW Libraries – Library Impact Statement
Program Change Proposal

Proposal Title: Applied Physics

Department: Department of Physics College: College of Arts and Sciences

Submitted by: Hai Nguyen

This form is to be completed by the University Librarian or the Collection Services Librarian. The signed form should accompany the Program Change Proposal submitted to the College Curriculum Committee.

Do the UMW Libraries already collect in this area? X Yes No

Rate the adequacy of each of the following collection areas:

	Insufficient	Adequate	Strong
Print books	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Electronic books	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Journals	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Databases	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Other resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comment on the strengths and weaknesses of the existing print and electronic collections.

The Libraries have adequate resources to support a new program in applied physics. Through VIVA, a statewide consortium for academic libraries, we have access to a number of electronic resources that support this program. In particular, we have subscriptions to IEEE/IET Electronic Library, ProQuest SciTech, IOPscience, Safari Books Online, and ENGnetBASE, which provide full-text access to important scholarly materials, including journals, e-books, handbooks, standards, and conference proceedings. Our recommendation is to begin selecting new monographs in this area, with a preference for electronic formats, which can be accomplished using existing collections funds. Additionally, we will want to monitor current VIVA subscriptions and reevaluate our ability to support this program if any of these resources are cancelled.

Estimated cost of new materials: n/a

Estimated ongoing costs: \$4395 VIVA cost shares for IEEE/IEL Electronic Library and IOPscience

Librarian signature: Summer Durant Date: March 27, 2018