The University Senate of Michigan Technological University

Proposal 26-26

Proposal to Establish a Graduate Certificate in Applied Physics

Basic Program Information

Primary Contact: Yoke Khin Yap, Ranjit Pati, Ravindra Pandey, Department of Physics
Program/Degree type: Graduate Certificate
Program Title: Graduate Certificate in Applied Physics
Planned Implementation Date: Fall 2026
Program location/modality: Online and Hybrid On-Campus
Target student population: New and Current Students

General description and characteristics of program

This Graduate Certificate in Applied Physics is intended to enable students to learn fundamental topics in applied physics. Applied physics bridges physics, engineering, and other sciences. Applied scientists will apply physics to solve interdisciplinary problems. The objectives of this certificate are to prepare students with a graduate-level foundation in applied physics and to enable them to explore new frontiers in one or more areas of interest, including optics/photonics materials and devices, big-data statistical analysis, advanced computation using machine-learning methods, and nano- and quantum materials and technology. Five existing courses are being developed into an online version to cover a diverse range of topics, reflect the nature of applied physics, and better prepare students for the field.

Catalog Description: The certificate in Applied Physics aims at developing the foundational knowledge in one or more applied physics areas, including 1) optics/photonics materials and devices, 2) big-data statistical analysis, 3) advanced computation using machine-learning methods, and 4) nano- and quantum materials and technology. Engineers and applied scientists would leverage these foundations towards emerging engineering systems.

Rationale

Applied Physics bridges the gap between physics, engineering, and other sciences. In view of the ever-changing technological landscape, engineers and applied scientists must strengthen their foundations to support the exploration of advanced computational methods, big data analysis, optics & photonics materials and devices, and nano/quantum materials and technology. This growing area is expected to meet many research and industrial needs.

Related programs: within MTU and at other institutions

Several other universities are offering similar certificate programs, for example,

(i) Johns Hopkins University: Applied Physics Post-Master Certificate. The certificate is part of their Applied Physics Online Master's program. Students choose any five courses, which must be completed within five years. The credit hour for each course is not clear from the website but the cost is $5,455 per course.

(ii) South Dakota State University: Applied Physics Certificate. This is a 12-credit graduate certificate, and courses are delivered face-to-face and online.

(iii) University of Vermont: Certificate of Graduate Study in Semiconductor Engineering and Physics. This is a 13-credit program for on-campus, part-time students in any engineering field as well as physics, chemistry, and mathematics, seeking hands-on experiences in semiconductor engineering, physics, and design.

(iv) Southern Connecticut State University: Physics Nanotechnology Graduate Certificate. This is a three-course graduate certificate program for on-campus full-time and part-time students.

(v) U Mass Lowell: The Department of Physics offers two Graduate Certificates in the areas of applied physics (Photonics and Radiological Health Physics). These programs are for on-campus part-time students. Both certificates required four courses (14 Credits).

Many universities offer graduate degree programs in applied physics, including the University of Michigan, Caltech, Harvard, MIT, Columbia University, Northwestern University, and Rice University. All these results suggest that Applied Physics is essential, and some schools have begun offering an online version.

Projected Enrollment

The certificate will be offered to both on- and off-campus students. Table 1 shows the estimated on-campus and online enrollment, depending on the efficiency of our marketing approach.

Table 1. Estimated minimum enrollment by year.

Academic Year	**In person**	**Online**	**Total**
2026-2027	0	0	0
2027-2028	2	0	2
2028-2029	4	2	6
2029-2030	5	5	10
2030-2031	6	9	15

Specialized Accreditation Requirements

No specialized accreditation is needed.

Professional Licensure Requirements

There are no professional licensure requirements.

Curriculum Details

Learning Goals

The Graduate Student Learning Objectives (GLO) of the Certificate are as follows,

GLO 1: Students earning this certificate will be able to evaluate and implement frameworks across specialized applied physics domains. The use of computational methods or statistical analysis for low-dimensional materials or photonic systems is one example.

GLO 2: Students earning this certificate will be able to appraise new technologies by reading professional documents based on what they learnt in one or more of the following areas: statistical analysis, computational methods, statistics, computational methods, optics & photonics, and low-dimensional materials.

Assessment Plan

The GLO evaluation will be performed at the end of every semester. All GLO data will then be compiled, analyzed, and assessed in an annual report to the graduate school.

Curriculum Design

This graduate certificate requires nine (9) credits.

All physics courses have been developed as online courses and will continue to be offered to on-campus students in a hybrid mode. The approval of this certificate will increase student enrollment in these courses by enabling remote students to take them. For on-campus students, instructors will arrange at least one weekly meeting to discuss course materials. In fact, PH 5320 and PH4292 are taught in a hybrid format in Fall 2025 to obtain students' feedback for improvement. PH5396 will be offered in a hybrid format in Spring 2026 for the same purpose. PH5530 was taught in the hybrid format in Spring 2019, 2023, and 2026 as a two-credit course. This course will be upgraded to three credits by adding new topics on quantum technology. The course name will also be changed for the first online offer in Spring 2027. Online office hours will be provided for remote students.

All the Physics online courses have been developed in close collaboration with the VP office of Global Campus since 2023. We have also discussed the plan with the Department of

Mathematical Sciences. They are enthusiastic about collaborating and further suggested more statistical courses as electives. We believe this approach will leverage the interest in the existing online Applied Statistics Master's degree program and the Certificate in Applied Physics proposed here.

Minimum Credits: 9 credits
Select three courses from the following lists.

Applied Physics Courses: select at least one course
PH 5320: Mathematical Physics (3 Credits)
- Pre-requisites: None

PH 5396: Statistics, Data Mining and Machine Learning in Astronomy (3 Credits)
- Pre-requisites: PH 4390

PH 5530: Nano- and Quantum- Materials and Technology (3 Credits)
- Pre-requisites: None
- This course is currently entitled "Selected Topics in Nanoscale Science and Technology" for 2 cr, but will be changed in the next curriculum update cycle

Undergraduate Courses (3 cr maximum)
PH 4292: Light and Photonic Materials (3 Credits, offered on demand)
- Pre-requisites: PH 2200

PH 4390: Computational Methods in Physics (3 Credits)
- Pre-requisites: (PH 2021 or PH 2020) and PH 3410)

Mathematics Courses (Optional, 3 cr maximum)
MA 5701: Statistical Methods (3 Credits)
- Pre-requisites: None

MA 5751: Statistical Data Mining (3 Credits, usually offered in spring, odd years mainly)
- Pre-requisites: (MA 4700 or MA 4760) and (MA 5701 or MA 4710)

MA 5761: Computational Statistics (3 Credits. usually offered in fall)
- Pre-requisites: MA 4770 or (MA 4700 and MA 5701)

MA 5781: Time Series Analysis and Forecasting (3 Credits, usually offered in spring)
- Pre-requisites: (MA 2710 or MA 2720 or MA 3710 or MA 3715 or MA 5701) and (MA 3720 or EE 3180 or MA 4700)

None of the PH courses have been offered as fully asynchronous online courses. Except for PH 4292, all PH courses are currently being offered in a hybrid format to on-campus students. All PH courses will be offered online from Fall 2026 and Spring 2027. All of the MA courses are offered as fully asynchronous online courses.

New Course Descriptions

No new courses are needed.

Model Schedule

Model-1

- Fall Semester (6 cr): PH 5320, PH 4390
- Spring Semester (3 cr): PH 5396

Model-2

- Fall Semester (6 cr): PH 5320, MA 5701
- Spring Semester (3 cr): PH 5396

Faculty Qualifications

The associated faculty who taught or can teach related courses are listed on the websites of the Department of Physics and the Department of Mathematics Sciences.

Name	Role	Role Detail
Elena Giusarma	Asst. Professor	Instructor of PH5320 or PH 5396
Mauricio Hurtado	Asst. Teaching Professor	Instructor of PH5320 or PH 5396
Yoke Khin Yap	Professor	Instructor of PH5530
Ranjit Pati	Professor	Instructor of PH5530
Qi Zhong	Asst. Professor	Instructor of PH4292
Issei Nakamura	Assoc. Professor	Instructor of PH4390

All of the above are Graduate Faculty. All faculty will have completed the required training for online teaching before the Fall 2026 semester.

Resources Needed

Library and other learning resources needed

Existing resources are sufficient.

Suitability of existing space, facilities, and equipment

Existing resources are sufficient.

Program Costs

There are no new costs in launching this graduate certificate.