UNIVERSITY OF MARYLAND
OFFICE OF THE SENIOR VICE PRESIDENT AND PROVOST

1119 Thomas V. Miller, Jr. Administration Building
College Park, Maryland 20742
301.405.5252 TEL 301.405.8195 FAX

May 8, 2025

MEMORANDUM

TO: Amitabh Varshney
Dean, College of Computer, Mathematical, and Natural Sciences

FROM: William Reed
Assistant Provost for Academic Planning

SUBJECT: Proposal to Modify the Master of Science in Quantum Computing (PCC Log No. 24093)

The proposal to modify the Master of Science in Quantum Computing has been administratively approved. **Please note that this curriculum change also applies to the online version of the program.** A copy of the approved proposal is attached.

The change is effective Fall 2025. The Graduate Catalog entry for the program will be updated by the Graduate School. Please ensure that the change is reflected in all other relevant descriptive materials.

If you are allowing current students to switch to the new curriculum, please advise them that they may now switch to the revised curriculum or remain on the previous curriculum. For current students who switch to the revised curriculum, please maintain documentation of the timing of their switch and enter appropriate exceptions in their degree audits to modify their degree requirements. The Graduate School can provide technical assistance with the degree audit (contact gradschool@umd.edu).

WLR/mdc
Enclosure

cc: Wendy Stickle, Chair, Senate PCC Committee
Shannon Gundy, Office of Enrollment Management
Veronica Marin, University Senate
Huifang Pan, Division of Information Technology
Pam Phillips, Institutional Research, Planning & Assessment
Natalie Trapuzzano, University Archives
Linda Yokoi, Office of the Registrar
Jason Farman, Graduate School
Leslie Pick, College of Computer, Mathematical, and Natural Sciences
Amy Chester, University of Maryland Science Academy

913: QUANTUM COMPUTING (SAQC)

In Workflow

1. D-CHPH PCC Chair (jcrosby@umd.edu)
2. D-CHPH Chair (wth@umd.edu)
3. CMNS PCC Chair (jpresson@umd.edu; lpick@umd.edu)
4. CMNS Dean (rinfanti@umd.edu)
5. Academic Affairs Curriculum Manager (mcolson@umd.edu)
6. Graduate School Curriculum Manager (jfarman@umd.edu; rlong12@umd.edu)
7. Graduate PCC Chair (jfarman@umd.edu; rlong12@umd.edu)
8. Dean of the Graduate School (jfarman@umd.edu; sroth1@umd.edu)
9. Senate PCC Chair (mcolson@umd.edu; wstickle@umd.edu)
10. Provost Office (mcolson@umd.edu)
11. Graduate Catalog Manager (bhernand@umd.edu; fantsao@umd.edu)

Approval Path

1. Fri, 28 Mar 2025 18:50:32 GMT
   Jessica Crosby (jcrosby): Approved for D-CHPH PCC Chair
2. Fri, 28 Mar 2025 19:22:17 GMT
   Wendell Hill (wth): Approved for D-CHPH Chair
3. Sun, 30 Mar 2025 20:52:48 GMT
   John Fourkas (fourkas): Approved for CMNS PCC Chair
4. Sun, 30 Mar 2025 23:13:01 GMT
   Robert Infantino (rinfanti): Approved for CMNS Dean
5. Fri, 11 Apr 2025 18:58:27 GMT
   Michael Colson (mcolson): Approved for Academic Affairs Curriculum Manager
6. Mon, 28 Apr 2025 16:38:08 GMT
   Jason Farman (jfarman): Approved for Graduate School Curriculum Manager
7. Mon, 28 Apr 2025 16:41:30 GMT
   Jason Farman (jfarman): Approved for Graduate PCC Chair
8. Mon, 28 Apr 2025 18:11:29 GMT
   Stephen Roth (sroth1): Approved for Dean of the Graduate School
9. Fri, 02 May 2025 18:30:59 GMT
   Wendy Stickle (wstickle): Approved for Senate PCC Chair
10. Fri, 09 May 2025 20:59:45 GMT
    Michael Colson (mcolson): Approved for Provost Office

History

1. Jun 14, 2024 by Konstantina Trivisa (trivisa)

New Program Proposal

Date Submitted: Fri, 28 Mar 2025 17:54:46 GMT

Viewing: 913 : Quantum Computing (SAQC)

Last approved: Fri, 14 Jun 2024 20:09:23 GMT

Last edit: Fri, 11 Apr 2025 17:51:35 GMT

Changes proposed by: Amy Chester (alevine)

Proposed Action

Curriculum Change

Program Name

Quantum Computing (SAQC)

Program Status

Active

Effective Term

Fall 2025

Catalog Year

2025-2026

Program Level

Graduate Program

Program Type

Master's

Delivery Method

On Campus

Departments

Department
Institute for Physical Sciences & Technology

Colleges

College
Computer, Mathematical, and Natural Sciences

Program/Major Code

SAQC

MHEC Inventory Program

Quantum Computing

CIP Code

27.0304 - 27.0304

HEGIS

170305

Degree(s) Awarded

Degree Awarded
Master of Science

Proposal Contact

Amy Chester

Proposal Summary

making MSQC603: Principles of Machine Learning an elective. Program will have 6 core and 4 elective courses.

(PCC Log Number 24093)

Program and Catalog Information

Provide the catalog description of the proposed program. As part of the description, please indicate any areas of concentration or specializations that will be offered.

The Masters of Science in Quantum Computing provides participants with foundational, practical and theoretical topics of quantum computing. Participants will discover current state-of-the-art quantum computing technology and areas of application, while also exploring its origins, evolution, and possible future states of this technology.

Experiential learning is at the core of the program with courses that provide ample opportunity for the participant to apply concepts on current-day commercial quantum computing hardware.

Special topics include quantum networks, quantum thermodynamics, quantum machine learning, quantum information theory, quantum Monte Carlo and simulations, and quantum computing hardware.

Catalog Program Requirements. Please click on the help bubble for more specific information about formatting requirements.

Course	Title	Credits
Core courses		
MSQC601	Course MSQC601 Not Found (Mathematics and Methods of Quantum Computing)	3
MSQC602	Course MSQC602 Not Found (The Physics of Quantum Devices)	3
MSQC604	Course MSQC604 Not Found (Quantum Computing Architectures and Algorithms)	3
MSQC605	Course MSQC605 Not Found (Advanced Topics in Quantum Computing)	3
MSQC606	Course MSQC606 Not Found (Practical Quantum Computing)	3
MSQC607	Course MSQC607 Not Found (Advanced Topics in Quantum Computing)	3
Elective courses		**12**
MSQC603	Principles of Machine Learning	
MSQC610	Course MSQC610 Not Found (Quantum Machine Learning- elective)	
MSQC611	Course MSQC611 Not Found (Quantum Networks- elective)	
MSQC612	Course MSQC612 Not Found (Quantum Computing Hardware- elective)	
MSQC613	Course MSQC613 Not Found (Quantum Monte Carlo and Applications- elective)	
MSQC614	Course MSQC614 Not Found (Quantum Information Theory- elective)	
MSQC615	Course MSQC615 Not Found (Quantum Thermodynamics- elective)	
Total Credits		**30**

Sample plan. Provide a term by term sample plan that shows how a hypothetical student would progress through the program to completion. It should be clear the length of time it will take for a typical student to graduate. For undergraduate programs, this should be the four-year plan.

Full time:

First Year

Semester 1	Credits	Semester 2	Credits	Semester 3	Credits
MSQC601 (The Mathematics and Methods of Quantum Computing)	3	MSQC604 (Quantum Computing Architectures and Algorithms)	3	MSQC612 or MSQC613 (Quantum Computing Hardware or Quantum Monte Carlo and Applications)	3
MSQC602 (Physics of Quantum Devices)	3	MSQC606 (Practical Quantum Computing)	3		
MSML/MSQC603 (Principles of Machine Learning)	3	MSQC608 or MSQC610 (Quantum Information Theory or Quantum Machine Learning)	3		
	9		**9**		**3**

Second Year

Semester 1	Credits
MSQC605 (Advanced Quantum Computing and Applications)	3
MSQC607 (Advanced Topics in Quantum Computing)	3
MSQC609 or MSQC611 (Quantum Thermodynamics or Quantum Networks)	3
	9

Total Credits 30

Sample Plan of Study (Part time)

Semester 1 (fall)

MSQC601 The Mathematics and Methods of Quantum Computing (core)
MSQC602 Physics of Quantum Devices (core)

Semester 2 (spring)

MSQC604 Quantum Computing Architectures and Algorithms (core)
[choose any one of the following]
MSQC608 Quantum Information Theory (elective)
MSQC610 Quantum Machine Learning (elective)

Semester 3 (summer)

[choose any one of the following]
MSQC612 Quantum Computing Hardware (elective)
MSQC613 Quantum Monte Carlo and Applications (elective)

Semester 4 (fall)

MSQC603 Principles of Machine Learning (core)
MSQC605 Advanced Quantum Computing and Applications (core)

Semester 5 (spring)
MSQC606 Practical Quantum Computing (core)

Semester 6 (fall)

MSQC607 Advanced Topics in Quantum Computing (core)
[choose any one of the following]
MSQC609 Quantum Thermodynamics (elective)
MSQC611 Quantum Networks (elective)

Use the space below for any additional comments on the courses or other requirements selected for the revised curriculum. Typical comments may be clarifications of why certain courses are being replaced or added.

MSQC 603 Principles of Machine Learning will move from a CORE course to an elective course. The curriculum committee for the program believes this content is not required for successful completion of the program.

List the intended student learning outcomes. In an attachment, provide the plan for assessing these outcomes.

Learning Outcomes
Explain principles of quantum physics as they apply to quantum computing.
Develop quantum computing programs and implement them on quantum computing platforms.
Distinguish the elements of a quantum computing algorithm and differentiate it from a classical algorithm.
Describe current quantum computing hardware, and examine the effects of its current state of maturity on the design of quantum computing algorithms.
Discuss and implement quantum computing paradigms to solve problems in quantum networks and quantum machine learning.
Compare quantum thermodynamics and quantum information theory and how they relate to classical information theory.

Program Modification Information

Description and Rationale for Modifications.

MSQC 603 Principles of Machine Learning will move from a CORE course to an elective course. The curriculum committee for the program believes this content is not required for successful completion of the program. The program will now have 6 required courses and 4 electives.

For new or modified courses, please provide the course catalog information (credits, description, prerequisites, etc.). Suffixed "Selected" or "Special" topics courses should be avoided. New courses and course modifications must be submitted through the course approval process at https://courseleaf.umd.edu/courseadmin. You may submit individual course changes through the course approval process concurrently with the program proposal; however, the course change approvals may be held until the program proposal is approved.

MSQC603 course will not be modified, but will now be an elective.

Impact on current students. It should be specifically acknowledged that students enrolled in the program prior to the effective date of any curriculum change may complete their program under the old requirements if they wish. The courses required must remain available, or suitable substitutions specifically designated.

Current students will not be impacted. We will continue to offer MSQC603 in future semesters as an elective course.

Linked Programs

Describe any selective admissions policy or special criteria for students interested in this program.

A four-year baccalaureate degree from a regionally accredited U.S. institution, or an equivalent degree from a non-U.S. institution

A 3.0 GPA (on a 4.0 scale) in all prior undergraduate and graduate coursework
Official copy of transcript for all post-secondary work

Curriculum vitae/resume

Personal statement including such elements as relevant experience and interests in engineering, mathematics, and natural sciences

Prior programming experience (Python preferred)

Quantitative abilities including coursework in Linear Algebra and Advanced Calculus

Select the academic calendar type for this program (calendar types with dates can be found on the Academic Calendar). Please click on the help bubble for more specific information.

Traditional Semester

For Master's degree programs, describe the thesis requirement and/or the non-thesis requirement.

Non-thesis requirement: complete all courses, 30 credits, with a 3.0 cumulative GPA or better.

Relationship to Other Units or Institutions

Accreditation and Licensure. Will the program need to be accredited? If so, indicate the accrediting agency. Also, indicate if students will expect to be licensed or certified in order to engage in or be successful in the program's target occupation.

No accreditation or licensure is required for the program.

Describe any cooperative arrangements with other institutions or organizations that will be important for the success of this program.

MSQC604 Quantum Computing Architectures and Algorithms and MSCQ605 Advanced Quantum Computing and Applications will be developed in collaboration with the Universities Space Research Association (USRA).

USRA will contribute industry perspective on in-demand skills and competencies, create real world problem sets/simulations/projects, identify prospective participants from government labs and private industry, and market the program.

Reviewer Comments

Michael Colson (mcolson) (Fri, 11 Apr 2025 18:59:22 GMT): Confirmed with CMNS that this modification also applies to the online version of the program.

Key: 913

Program Change Request

Date Submitted: 03/28/25 1:54 pm

Viewing: 913 : Quantum Computing (SAQC)

Last approved: 06/14/24 4:09 pm

Last edit: 04/11/25 1:51 pm

Changes proposed by: Amy Chester (alevine)

Catalog Pages Using this Program

Quantum Computing, Master of Science (M.S.)

Proposed Action Curriculum Change

Program Name

In Workflow

1. D-CHPH PCC Chair
2. D-CHPH Chair
3. CMNS PCC Chair
4. CMNS Dean
5. Academic Affairs Curriculum Manager
6. Graduate School Curriculum Manager
7. Graduate PCC Chair
8. Dean of the Graduate School
9. Senate PCC Chair
10. Provost Office
11. Graduate Catalog Manager

Approval Path

1. 03/28/25 2:50 pm Jessica Crosby (jcrosby): Approved for D-CHPH PCC Chair
2. 03/28/25 3:22 pm Wendell Hill (wth): Approved for D-CHPH Chair
3. 03/30/25 4:52 pm John Fourkas (fourkas): Approved for CMNS PCC Chair
4. 03/30/25 7:13 pm Robert Infantino (rinfanti): Approved

for CMNS Dean
5. 04/11/25 2:58 pm Michael Colson (mcolson): Approved for Academic Affairs Curriculum Manager
6. 04/28/25 12:38 pm Jason Farman (jfarman): Approved for Graduate School Curriculum Manager
7. 04/28/25 12:41 pm Jason Farman (jfarman): Approved for Graduate PCC Chair
8. 04/28/25 2:11 pm Stephen Roth (sroth1): Approved for Dean of the Graduate School
9. 05/02/25 2:30 pm Wendy Stickle (wstickle): Approved for Senate PCC Chair
10. 05/09/25 4:59 pm Michael Colson (mcolson): Approved for Provost Office

History

1. Jun 14, 2024 by Konstantina Trivisa (trivisa)

Quantum Computing (SAQC)

Program Status	Active
Effective Term	Fall 2025
Catalog Year	2025-2026 ~~2023-2024~~
Program Level	Graduate Program
Program Type	Master's
Delivery Method	On Campus

Departments

Department
Institute for Physical Sciences & Technology

Colleges

College
Computer, Mathematical, and Natural Sciences

Program/Major Code	SAQC
MHEC Inventory Program	Quantum Computing
CIP Code	27.0304 - 27.0304
HEGIS	170305
MHEC Recognized Area(s) of Concentration	

Degree(s) Awarded

Degree Awarded
Master of Science

If other, new degree award:

Proposal Contact

~~Konstantina Trivisa,~~ Amy Chester

Proposal Summary

making MSQC603: Principles of Machine Learning an elective. Program will have 6 core and 4 elective courses. ~~27.0304 Computational and Applied Mathematics~~

~~This proposal is to convert the approved MPS in Quantum Computing to an MS in~~

~~QuantumComputing.No curriculum changes proposed to the approvedprogram.CIPCode:~~(PCC Log Number 24093) ~~23048)~~

Program and Catalog Information

Provide the catalog description of the proposed program. As part of the description, please indicate any areas of concentration or specializations that will be offered.

The Masters of Science in Quantum Computing provides participants with foundational, practical and theoretical topics of quantum computing. Participants will discover current state-of-the-art quantum computing technology and areas of application, while also exploring its origins, evolution, and possible future states of this technology. Experiential learning is at the core of the program with courses that provide ample opportunity for the participant to apply concepts on current-day commercial quantum computing hardware.
Special topics include quantum networks, quantum thermodynamics, quantum machine learning, quantum information theory, quantum Monte Carlo and simulations, and quantum computing hardware.

Catalog Program Requirements. Please click on the help bubble for more specific information about formatting requirements.

Course	Title	Credits
Core courses		
MSQC601	Course MSQC601 Not Found (Mathematics and Methods of Quantum Computing)	3
MSQC602	Course MSQC602 Not Found (The Physics of Quantum Devices)	3
MSQC604	Course MSQC604 Not Found (Quantum Computing Architectures and Algorithms)	3
MSQC605	Course MSQC605 Not Found (Advanced Topics in Quantum Computing)	3
MSQC606	Course MSQC606 Not Found (Practical Quantum Computing)	3
MSQC607	Course MSQC607 Not Found (Advanced Topics in Quantum Computing)	3
Elective courses		**12**
MSQC603	Principles of Machine Learning	
MSQC610	Course MSQC610 Not Found (Quantum Machine Learning- elective)	
MSQC611	Course MSQC611 Not Found (Quantum Networks- elective)	
MSQC612	Course MSQC612 Not Found (Quantum Computing Hardware- elective)	

Course	Title	Credits
MSQC613	Course MSQC613 Not Found (Quantum Monte Carlo and Applications- elective)	
MSQC614	Course MSQC614 Not Found (Quantum Information Theory- elective)	
MSQC615	Course MSQC615 Not Found (Quantum Thermodynamics- elective)	
Total Credits		30

~~The Master of Science in Quantum Computing requires 30 credits including 7 core courses and 3electives.~~

Sample plan. Provide a term by term sample plan that shows how a hypothetical student would progress through the program to completion. It should be clear the length of time it will take for a typical student to graduate. For undergraduate programs, this should be the four-year plan.

Full time:

First Year

Semester 1	Credits	Semester 2	Credits	Semester 3	Credits
MSQC601 (The Mathematics and Methods of Quantum Computing)	3	MSQC604 (Quantum Computing Architectures and Algorithms)	3	MSQC612 or MSQC613 (Quantum Computing Hardware or Quantum Monte Carlo and Applications)	3
MSQC602 (Physics of Quantum Devices)	3	MSQC606 (Practical Quantum Computing)	3		
MSML/MSQC603 (Principles of Machine Learning)	3	MSQC608 or MSQC610 (Quantum Information Theory or Quantum Machine Learning)	3		
	9		9		3

Second Year

Semester 1	Credits
MSQC605 (Advanced Quantum Computing and Applications)	3
MSQC607 (Advanced Topics in Quantum Computing)	3
MSQC609 or MSQC611 (Quantum Thermodynamics or Quantum Networks)	3
	9

Total Credits 30

Sample Plan of Study (Part time)

Semester 1 (fall)

MSQC601 The Mathematics and Methods of Quantum Computing (core)

MSQC602 Physics of Quantum Devices (core)

Semester 2 (spring)

MSQC604 Quantum Computing Architectures and Algorithms (core)

[choose any one of the following]

MSQC608 Quantum Information Theory (elective)

MSQC610 Quantum Machine Learning (elective)

Semester 3 (summer)

[choose any one of the following]
MSQC612 Quantum Computing Hardware (elective)
MSQC613 Quantum Monte Carlo and Applications (elective)
Semester 4 (fall)
MSQC603 Principles of Machine Learning (core)
MSQC605 Advanced Quantum Computing and Applications (core)
Semester 5 (spring)
MSQC606 Practical Quantum Computing (core)
Semester 6 (fall)
MSQC607 Advanced Topics in Quantum Computing (core)
[choose any one of the following]
MSQC609 Quantum Thermodynamics (elective)
MSQC611 Quantum Networks (elective)

Use the space below for any additional comments on the courses or other requirements selected for the revised curriculum. Typical comments may be clarifications of why certain courses are being replaced or added.

MSQC 603 Principles of Machine Learning will move from a CORE course to an elective course. The curriculum committee for the program believes this content is not required for successful completion of the program.

List the intended student learning outcomes. In an attachment, provide the plan for assessing these outcomes.

Learning Outcomes
Explain principles of quantum physics as they apply to quantum computing.
Develop quantum computing programs and implement them on quantum computing platforms.
Distinguish the elements of a quantum computing algorithm and differentiate it from a classical algorithm.
Describe current quantum computing hardware, and examine the effects of its current state of maturity on the design of quantum computing algorithms.
Discuss and implement quantum computing paradigms to solve problems in quantum networks and quantum machine learning.
Compare quantum thermodynamics and quantum information theory and how they relate to classical information theory.

Program Modification Information

Description and Rationale for Modifications.

MSQC 603 Principles of Machine Learning will move from a CORE course to an elective course. The curriculum committee for the program believes this content is not required for successful completion of the program. The program will now have 6 required courses and 4 electives.

For new or modified courses, please provide the course catalog information (credits, description, prerequisites, etc.). Suffixed "Selected" or "Special" topics courses should be avoided. New courses and course modifications must be submitted through the course approval process at https://courseleaf.umd.edu/courseadmin. You may submit individual course changes through the course approval process concurrently with the program proposal; however, the course change approvals may be held until the program proposal is approved.

MSQC603 course will not be modified, but will now be an elective.

Impact on current students. It should be specifically acknowledged that students enrolled in the program prior to the effective date of any curriculum change may complete their program under the old requirements if they wish. The courses required must remain available, or suitable substitutions specifically designated.

Current students will not be impacted. We will continue to offer MSQC603 in future semesters as an elective course.

Linked Programs

Indicate in the space below all programs to which this program is formally linked (e.g., approved combined bachelor's/master's programs, dual master's programs, or joint-programs with other universities). If the proposed modification will affect the linked program, provide as an attachment the new curriculum for each arrangement and provide supporting correspondence from the director of the linked program.

Describe any selective admissions policy or special criteria for students interested in this program.

A four-year baccalaureate degree from a regionally accredited U.S. institution, or an equivalent degree from a non-U.S. institution

A 3.0 GPA (on a 4.0 scale) in all prior undergraduate and graduate coursework
Official copy of transcript for all post-secondary work

Curriculum vitae/resume

Personal statement including such elements as relevant experience and interests in engineering, mathematics, and natural sciences

Prior programming experience (Python preferred)

Quantitative abilities including coursework in Linear Algebra and Advanced Calculus

Select the academic calendar type for this program (calendar types with dates can be found on the Academic Calendar). Please click on the help bubble for more specific information.

Traditional Semester

For Master's degree programs, describe the thesis requirement and/or the non-thesis requirement.

Non-thesis requirement: complete all courses, 30 credits, with a 3.0 cumulative GPA or better.

Relationship to Other Units or Institutions

If a required or recommended course is offered by another department, discuss how the additional students will not unduly burden that department's faculty and resources. Discuss any other potential impacts on another department, such as academic content that may significantly overlap with existing programs. Use space below for any comments. Otherwise, attach supporting correspondence.

~~One course is shared across existing programs in the Science Academy, DATA/MSML 603:Principles of Machine Learning.Other courses will be new courses and should not burden department's faculty or resources.New courses will be developed and delivered by a combination of tenure-track or professional-track faculty teaching on overload and adjuncts.~~

Accreditation and Licensure. Will the program need to be accredited? If so, indicate the accrediting agency. Also, indicate if students will expect to be licensed or certified in order to engage in or be successful in the program's target occupation.

No accreditation or licensure is required for the program.

Describe any cooperative arrangements with other institutions or organizations that will be important for the success of this program.

MSQC604 Quantum Computing Architectures and Algorithms and MSCQ605 Advanced Quantum Computing and Applications will be developed in collaboration with the Universities Space Research Association (USRA).

USRA will contribute industry perspective on in-demand skills and competencies, create real world problem sets/simulations/projects, identify prospective participants from government labs and private industry, and market the program.

Supporting Documents

Attachments

~~Faculty List Template- Quantum.docx~~
~~PGP_Benchmark_Quantum_Computing_MPS 2023.xlsx~~
~~Collection_Assessment_MPS_QuantumComputing_2022.docx~~
~~MS in Quantum Computing Budget.xlsx~~
~~Quantum Learning Outcomes and Assessment.pdf~~
~~Quantum- Curriculum- MS in Quantum Computing.pdf~~

Administrative Documents

~~PCC_Presidential_Approval_23-24-19.pdf~~
~~MHEC Approval 24095 University of Maryland College Park MS Quantum Computing.pdf~~
~~BOR Approval UMCP - Master of Science in Quantum Computing.pdf~~

Reviewer Comments

Michael Colson (mcolson) (04/11/25 2:59 pm): Confirmed with CMNS that this modification also applies to the online version of the program.

Key: 913

916: QUANTUM COMPUTING (ONLINE) (SAQO)

In Workflow

1. Provost Office (mcolson@umd.edu)
2. Graduate Catalog Manager (bhernand@umd.edu; fantsao@umd.edu)

Approval Path

1. Fri, 09 May 2025 20:59:47 GMT
   Michael Colson (mcolson): Approved for Provost Office

History

1. Jun 14, 2024 by Konstantina Trivisa (trivisa)

New Program Proposal

Date Submitted: Thu, 08 May 2025 20:50:38 GMT

Viewing: 916 : Quantum Computing (online) (SAQO)
Last approved: Fri, 14 Jun 2024 20:09:27 GMT
Last edit: Thu, 08 May 2025 20:50:37 GMT

Changes proposed by: Michael Colson (mcolson)

Proposed Action

Curriculum Change

Program Name

Quantum Computing (online) (SAQO)

Program Status

Active

Effective Term

Fall 2025

Catalog Year

2025-2026

Program Level

Graduate Program

Program Type

Master's

Delivery Method

Online

Departments

Department
Institute for Physical Sciences & Technology

Colleges

College
Computer, Mathematical, and Natural Sciences

Program/Major Code

SAQO

MHEC Inventory Program

Quantum Computing

CIP Code

27.0304 - 27.0304

HEGIS

170305

Degree(s) Awarded

Degree Awarded
Master of Science

Proposal Summary

Updating the program curriculum based on approved proposal to modify the in person version. See PCC proposal 24093

Program and Catalog Information

Provide the catalog description of the proposed program. As part of the description, please indicate any areas of concentration or specializations that will be offered.

The Masters of Science in Quantum Computing provides participants with foundational, practical and theoretical topics of quantum computing. Participants will discover current state-of-the-art quantum computing technology and areas of application, while also exploring its origins, evolution, and possible future states of this technology.

Experiential learning is at the core of the program with courses that provide ample opportunity for the participant to apply concepts on current-day commercial quantum computing hardware.

Special topics include quantum networks, quantum thermodynamics, quantum machine learning, quantum information theory, quantum Monte Carlo and simulations, and quantum computing hardware.

The Master of Science in Quantum Computing requires 30 credits including 7 core courses and 3 electives.

Catalog Program Requirements. Please click on the help bubble for more specific information about formatting requirements.

The Master of Science in Quantum Computing requires 30 credits including 7 core courses and 3 electives.

Course	Title	Credits
Core courses		
MSQC601	Course MSQC601 Not Found (Mathematics and Methods of Quantum Computing)	3
MSQC602	Course MSQC602 Not Found (The Physics of Quantum Devices)	3
MSQC604	Course MSQC604 Not Found (Quantum Computing Architectures and Algorithms)	3
MSQC605	Course MSQC605 Not Found (Advanced Topics in Quantum Computing)	3
MSQC606	Course MSQC606 Not Found (Practical Quantum Computing)	3
MSQC607	Course MSQC607 Not Found (Advanced Topics in Quantum Computing)	3
Elective courses		**12**
MSQC603	Principles of Machine Learning	
MSQC610	Course MSQC610 Not Found (Quantum Machine Learning (elective))	
MSQC611	Course MSQC611 Not Found (Quantum Networks- elective)	
MSQC612	Course MSQC612 Not Found (Quantum Computing Hardware- elective)	
MSQC613	Course MSQC613 Not Found (Quantum Monte Carlo and Applications- elective)	
MSQC614	Course MSQC614 Not Found (Quantum Information Theory- elective)	
MSQC615	Course MSQC615 Not Found (Quantum Thermodynamics- elective)	
Total Credits		**30**

Sample plan. Provide a term by term sample plan that shows how a hypothetical student would progress through the program to completion. It should be clear the length of time it will take for a typical student to graduate. For undergraduate programs, this should be the four-year plan.

First Year

Semester 1	Credits	Semester 2	Credits	Semester 3	Credits
MSQC601 (The Mathematics and Methods of Quantum Computing)	3	MSQC604 (Quantum Computing Architectures and Algorithms)	3	MSQC612 or MSQC613 (Quantum Computing Hardware or Quantum Monte Carlo and Applications)	3
MSQC602 (Physics of Quantum Devices)	3	MSQC606 (Practical Quantum Computing)	3		

MSML603 (Principles of Machine Learning)	3	MSQC608 or MSQC610 (Quantum Information Theory or Quantum Machine Learning)	3	
	9		**9**	**3**

Second Year

Semester 1	**Credits**
MSQC605 (Advanced Quantum Computing and Applications)	3
MSQC607 (Advanced Topics in Quantum Computing)	3
MSQC609 or MSQC611 (Quantum Thermodynamics or Quantum Networks)	3
	9

Total Credits 30

Sample Plan of Study (Part time)

Semester 1 (fall)

MSQC601 The Mathematics and Methods of Quantum Computing (core)
MSQC602 Physics of Quantum Devices (core)

Semester 2 (spring)

MSQC604 Quantum Computing Architectures and Algorithms (core)
[choose any one of the following]
MSQC608 Quantum Information Theory (elective)
MSQC610 Quantum Machine Learning (elective)

Semester 3 (summer)

[choose any one of the following]
MSQC612 Quantum Computing Hardware (elective)
MSQC613 Quantum Monte Carlo and Applications (elective)

Semester 4 (fall)

MSQC603 Principles of Machine Learning (core)
MSQC605 Advanced Quantum Computing and Applications (core)

Semester 5 (spring)
MSQC606 Practical Quantum Computing (core)

Semester 6 (fall)

MSQC607 Advanced Topics in Quantum Computing (core)
[choose any one of the following]
MSQC609 Quantum Thermodynamics (elective)
MSQC611 Quantum Networks (elective)

List the intended student learning outcomes. In an attachment, provide the plan for assessing these outcomes.

Learning Outcomes
Explain principles of quantum physics as they apply to quantum computing.
Develop quantum computing programs and implement them on quantum computing platforms.
Distinguish the elements of a quantum computing algorithm and differentiate it from a classical algorithm.
Describe current quantum computing hardware, and examine the effects of its current state of maturity on the design of quantum computing algorithms.
Discuss and implement quantum computing paradigms to solve problems in quantum networks and quantum machine learning.
Compare quantum thermodynamics and quantum information theory and how they relate to classical information theory.

Program Modification Information

Linked Programs

Describe any selective admissions policy or special criteria for students interested in this program.

A four-year baccalaureate degree from a regionally accredited U.S. institution, or an equivalent degree from a non-U.S. institution

A 3.0 GPA (on a 4.0 scale) in all prior undergraduate and graduate coursework

Official copy of transcript for all post-secondary work

Curriculum vitae/resume

Personal statement including such elements as relevant experience and interests in engineering, mathematics, and natural sciences

Prior programming experience (Python preferred)

Quantitative abilities including coursework in Linear Algebra and Advanced Calculus

Select the academic calendar type for this program (calendar types with dates can be found on the Academic Calendar). Please click on the help bubble for more specific information.

Traditional Semester

For Master's degree programs, describe the thesis requirement and/or the non-thesis requirement.

Non-thesis requirement: complete all courses, 30 credits, with a 3.0 cumulative GPA or better.

Relationship to Other Units or Institutions

Accreditation and Licensure. Will the program need to be accredited? If so, indicate the accrediting agency. Also, indicate if students will expect to be licensed or certified in order to engage in or be successful in the program's target occupation.

No accreditation or licensure is required for the program.

Describe any cooperative arrangements with other institutions or organizations that will be important for the success of this program.

MSQC604 Quantum Computing Architectures and Algorithms and MSCQ605 Advanced Quantum Computing and Applications will be developed in collaboration with the Universities Space Research Association (USRA).

USRA will contribute industry perspective on in-demand skills and competencies, create real world problem sets/simulations/projects, identify prospective participants from government labs and private industry, and market the program.

Key: 916

Program Change Request

Date Submitted: 05/08/25 4:50 pm

Viewing: **916 : Quantum Computing (online) (SAQO)**

Last approved: 06/14/24 4:09 pm

Last edit: 05/08/25 4:50 pm

Changes proposed by: Michael Colson (mcolson)

In Workflow

1. **Provost Office**
2. **Graduate Catalog Manager**

Approval Path

1. 05/09/25 4:59 pm Michael Colson (mcolson): Approved for Provost Office

History

1. Jun 14, 2024 by Konstantina Trivisa (trivisa)

Proposed Action	Curriculum Change
Program Name	

Quantum Computing (online) (SAQO)

Program Status	Active
Effective Term	Fall 2025
Catalog Year	2025-2026 ~~2024-2025~~
Program Level	Graduate Program
Program Type	Master's
Delivery Method	Online
Departments	Department: Institute for Physical Sciences & Technology
Colleges	College: Computer, Mathematical, and Natural Sciences
Program/Major Code	SAQO

MHEC Inventory Program	Quantum Computing
CIP Code	27.0304 - 27.0304
HEGIS	170305
MHEC Recognized Area(s) of Concentration	

Degree(s) Awarded

Degree Awarded
Master of Science

If other, new degree award:

Proposal Contact

~~Konstantina Trivisa, Amy Chester~~

Proposal Summary

Updating ~~This proposal is to convert~~ the program curriculum based on approved proposal to modify the in person version. ~~MPS in Quantum Computing to an Online MS in Quantum Computing.~~ See PCC proposal 24093 ~~No curriculum changes proposed to the approved program.CIP Code:27.0304 Computational and Applied Mathematics (PCC Log Number 23049)~~

Program and Catalog Information

Provide the catalog description of the proposed program. As part of the description, please indicate any areas of concentration or specializations that will be offered.

The Masters of Science in Quantum Computing provides participants with foundational, practical and theoretical topics of quantum computing. Participants will discover current state-of-the-art quantum computing technology and areas of application, while also exploring its origins, evolution, and possible future states of this technology. Experiential learning is at the core of the program with courses that provide ample opportunity for the participant to apply concepts on current-day commercial quantum computing hardware.
Special topics include quantum networks, quantum thermodynamics, quantum machine learning, quantum information theory, quantum Monte Carlo and simulations, and quantum computing hardware.
The Master of Science in Quantum Computing requires 30 credits including 7 core courses and 3 electives.

Catalog Program Requirements. Please click on the help bubble for more specific information about formatting

requirements.

The Master of Science in Quantum Computing requires 30 credits including 7 core courses and 3 electives.

Course	Title	Credits
Core courses		
MSQC601	Course MSQC601 Not Found (Mathematics and Methods of Quantum Computing)	3
MSQC602	Course MSQC602 Not Found (The Physics of Quantum Devices)	3
MSQC604	Course MSQC604 Not Found (Quantum Computing Architectures and Algorithms)	3
MSQC605	Course MSQC605 Not Found (Advanced Topics in Quantum Computing)	3
MSQC606	Course MSQC606 Not Found (Practical Quantum Computing)	3
MSQC607	Course MSQC607 Not Found (Advanced Topics in Quantum Computing)	3
Elective courses		**12**
MSQC603	Principles of Machine Learning	
MSQC610	Course MSQC610 Not Found (Quantum Machine Learning (elective))	
MSQC611	Course MSQC611 Not Found (Quantum Networks- elective)	
MSQC612	Course MSQC612 Not Found (Quantum Computing Hardware- elective)	
MSQC613	Course MSQC613 Not Found (Quantum Monte Carlo and Applications- elective)	
MSQC614	Course MSQC614 Not Found (Quantum Information Theory- elective)	
MSQC615	Course MSQC615 Not Found (Quantum Thermodynamics- elective)	
Total Credits		30

Sample plan. Provide a term by term sample plan that shows how a hypothetical student would progress through the program to completion. It should be clear the length of time it will take for a typical student to graduate. For undergraduate programs, this should be the four-year plan.

First Year					
Semester 1	Credits	Semester 2	Credits	Semester 3	Credits
MSQC601 (The Mathematics and Methods of Quantum Computing)	3	MSQC604 (Quantum Computing Architectures and Algorithms)	3	MSQC612 or MSQC613 (Quantum Computing Hardware or Quantum Monte Carlo and Applications)	3
MSQC602 (Physics of Quantum Devices)	3	MSQC606 (Practical Quantum Computing)	3		
MSML603 (Principles of Machine Learning)	3	MSQC608 or MSQC610 (Quantum Information Theory or Quantum Machine Learning)	3		
	9		9		3

Second Year	
Semester 1	Credits
MSQC605 (Advanced Quantum Computing and Applications)	3
MSQC607 (Advanced Topics in Quantum Computing)	3
MSQC609 or MSQC611 (Quantum Thermodynamics or Quantum Networks)	3
	9

Total Credits 30

Sample Plan of Study (Part time)

Semester 1 (fall)

MSQC601 The Mathematics and Methods of Quantum Computing (core)

MSQC602 Physics of Quantum Devices (core)

Semester 2 (spring)

MSQC604 Quantum Computing Architectures and Algorithms (core)

[choose any one of the following]

MSQC608 Quantum Information Theory (elective)

MSQC610 Quantum Machine Learning (elective)

Semester 3 (summer)

[choose any one of the following]

MSQC612 Quantum Computing Hardware (elective)
MSQC613 Quantum Monte Carlo and Applications (elective)
Semester 4 (fall)
MSQC603 Principles of Machine Learning (core)
MSQC605 Advanced Quantum Computing and Applications (core)
Semester 5 (spring)
MSQC606 Practical Quantum Computing (core)
Semester 6 (fall)
MSQC607 Advanced Topics in Quantum Computing (core)
[choose any one of the following]
MSQC609 Quantum Thermodynamics (elective)
MSQC611 Quantum Networks (elective)

Use the space below for any additional comments on the courses or other requirements selected for the revised curriculum. Typical comments may be clarifications of why certain courses are being replaced or added.

List the intended student learning outcomes. In an attachment, provide the plan for assessing these outcomes.

Learning Outcomes
Explain principles of quantum physics as they apply to quantum computing.
Develop quantum computing programs and implement them on quantum computing platforms.
Distinguish the elements of a quantum computing algorithm and differentiate it from a classical algorithm.
Describe current quantum computing hardware, and examine the effects of its current state of maturity on the design of quantum computing algorithms.
Discuss and implement quantum computing paradigms to solve problems in quantum networks and quantum machine learning.
Compare quantum thermodynamics and quantum information theory and how they relate to classical information theory.

Program Modification Information

Description and Rationale for Modifications.

For new or modified courses, please provide the course catalog information (credits, description, prerequisites, etc.). Suffixed "Selected" or "Special" topics courses should be avoided. New courses and course modifications must be submitted through the course approval process at https://courseleaf.umd.edu/courseadmin. You may submit individual course changes through the course approval process concurrently with the program proposal; however, the course change approvals may be held until the program proposal is approved.

Impact on current students. It should be specifically acknowledged that students enrolled in the program prior to the effective date of any curriculum change may complete their program under the old requirements if they wish. The courses required must remain available, or suitable substitutions specifically designated.

Linked Programs

Indicate in the space below all programs to which this program is formally linked (e.g., approved combined bachelor's/master's programs, dual master's programs, or joint-programs with other universities). If the proposed modification will affect the linked program, provide as an attachment the new curriculum for each arrangement and provide supporting correspondence from the director of the linked program.

Describe any selective admissions policy or special criteria for students interested in this program.

A four-year baccalaureate degree from a regionally accredited U.S. institution, or an equivalent degree from a non-U.S. institution

A 3.0 GPA (on a 4.0 scale) in all prior undergraduate and graduate coursework

Official copy of transcript for all post-secondary work

Curriculum vitae/resume

Personal statement including such elements as relevant experience and interests in engineering, mathematics, and natural sciences

Prior programming experience (Python preferred)

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Select the academic calendar type for this program (calendar types with dates can be found on

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Traditional Semester

For Master's degree programs, describe the thesis requirement and/or the non-thesis requirement.

Non-thesis requirement: complete all courses, 30 credits, with a 3.0 cumulative GPA or better.

Relationship to Other Units or Institutions

If a required or recommended course is offered by another department, discuss how the additional students will not unduly burden that department's faculty and resources. Discuss any other potential impacts on another department, such as academic content that may significantly overlap with existing programs. Use space below for any comments. Otherwise, attach supporting correspondence.

~~One course is shared across existing programs in the Science Academy, DATA/MSML 603:Principles of Machine Learning.Other courses will be new courses and should not burden department's faculty or resources.New courses will be developed and delivered by a combination of tenure-track or professional-track faculty teaching on overload and adjuncts.~~

Accreditation and Licensure. Will the program need to be accredited? If so, indicate the accrediting agency. Also, indicate if students will expect to be licensed or certified in order to engage in or be successful in the program's target occupation.

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Supporting Documents

Attachments

~~Faculty List Template- Quantum.docx~~

~~Collection_Assessment_MPS_QuantumComputing_2022.docx~~

~~PGP_Benchmark_Quantum_Computing_MPS 2023.xlsx~~

~~MS in Quantum Computing Budget.xlsx~~

~~Quantum Learning Outcomes and Assessment.pdf~~

~~Quantum- Curriculum- MS in Quantum Computing.pdf~~

Administrative

Documents

~~PCC_Presidential_Approval_23-24-19.pdf~~

~~BOR Approval UMCP - Master of Science in Quantum Computing.pdf~~

~~MHEC Approval 24095 University of Maryland College Park MS Quantum Computing.pdf~~

Reviewer

Comments

Key: 916