

Quantum Materials Science BS

Overview

The **Bachelor of Science in Quantum Materials Science**, offered by the Department of Physics, provides both a strong preparation for those wishing to attend graduate school in materials science or related disciplines and for those who intend to enter the scientific workforce upon completion of a bachelor's degree. Students who wish to transfer into this program should consult first with the Physics faculty advisor.

The Bachelor of Science in Quantum Materials Science stands at the interface between physics, chemistry, computer and information science, and applied mathematics, with innovation and technology applications bridging to applied sciences. Its foundational structure is embedded in multiple College of Science and Technology (CST) disciplines. Quantum materials science is important as a research and education driver that reaches students in almost every discipline of science and technology. Graduates proficient in this area are more and more in demand. Indeed, the national initiative in Quantum Information Science makes it clear that Quantum Materials Science will be a focus for industry and academia. Temple's Bachelor of Science in Quantum Materials Science focuses on the science behind quantum materials science, and is not an engineering program.

As a discipline, Quantum Materials Science represents the confluence of quantum theory, computational design, synthesis and characterization, in a feedback loop to produce advanced materials for technology applications and subsequent processing by industry. Importantly, the theory and computational design component now harnesses artificial intelligence and machine learning to create heretofore unknown "designer" materials. These ideas are prominent in Department of Energy (DOE) and National Science Foundation "big ideas" such as the "Quantum Leap" that establish an understanding of complex matter-energy relationships, leading to next-generation quantum materials and technologies for sensing and computing, modeling, and communicating, from the micro- or nano-structure of materials to their physical, mechanical and chemical properties.

Quantum Materials Science evolved historically from the metallurgy of naturally occurring elements and their alloys (and glass) to embrace not only an enormous variety of "hard" elemental (metallic and semiconducting) alloys and oxide-based materials (superconductors, catalysts, etc.) that underpin technology applications, but also a vast array of "soft" materials including synthetic and natural polymers, as well as more recently the two-dimensional graphene-like constructs, which will be needed for future advanced/strategic technologies.

Campus Location: Main

Program Code: ST-QMSC-BS

Distinction in Major

To graduate with distinction in this major, a student must satisfy the following criteria:

- achieve a minimum 3.5 major GPA and
- carry out an independent study or undergraduate thesis project.

Consult the undergraduate physics faculty advisor for more details.

Undergraduate Contact Information

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Learn more about the Bachelor of Science in Quantum Materials Science.

These requirements are for students who matriculated in academic year 2024-2025. Students who matriculated prior to fall 2024 should refer to the Archives to view the requirements for their Bulletin year.

Bachelor of Science Requirements

Summary of Requirements for the Degree

1. University Requirements (123 total s.h.)

- Students must complete all University requirements including those listed below.
- All undergraduate students must complete at least two writing-intensive courses for a total of at least six credits at Temple as part of their major. The specific writing-intensive course options for this major are:

Code	Title	Credit Hours
PHYS 2796	Introduction to Modern Physics	4
SCTC 2396	Writing for Science and Technology	3

- Students must complete the General Education (GenEd) requirements.
 - See the General Education section of the *Undergraduate Bulletin* for the GenEd curriculum.
 - Students who complete CST majors receive a waiver for 2 Science & Technology (GS) and 1 Quantitative Literacy (GQ) GenEd courses.
- Students must satisfy general Temple University residency requirements.

2. College Requirements

- A minimum of 90 total credits within the College of Science & Technology (CST), the College of Liberal Arts (CLA), and/or the College of Engineering (ENG).
 - A minimum of 45 of these credits must be upper-level (courses numbered 2000 and above).
- Complete a one-credit first-year or transfer seminar.
 - SCTC 1001 CST First Year Seminar for every entering first-year CST student.
 - SCTC 2001 CST Transfer Seminar for every entering transfer CST student.

3. Major Requirements for Bachelor of Science (76-80 s.h.)

A least 9 courses required for the major must be completed at Temple. At least 8 Physics courses must be completed at Temple.

Code	Title	Credit Hours
Chemistry		
Select one of the following:		4
CHEM 1031 & CHEM 1033	General Chemistry I and General Chemistry Laboratory I	
CHEM 1951 & CHEM 1953	Honors General Chemical Science I and Honors Chemical Science Laboratory I	
Select one of the following:		4
CHEM 1032 & CHEM 1034	General Chemistry II and General Chemistry Laboratory II	
CHEM 1952 & CHEM 1954	Honors General Chemical Science II and Honors Chemical Science Laboratory II	
Mathematics and Quantitative Methods		
MATH 1041 or MATH 1941	Calculus I Honors Calculus I	4
MATH 1042 or MATH 1942	Calculus II Honors Calculus II	4
MATH 2043 or MATH 2943	Calculus III Honors Calculus III	4
Select one of the following		3-4
MATH 2041	Differential Equations I	
MATH 2045	Differential Equations with Linear Algebra	
MATH 2941	Honors Differential Equations I	
SCTC 1013	Elements of Data Science for the Physical and Life Sciences	3
Physics		
Select one of the following:		4
PHYS 1061	Elementary Classical Physics I	
PHYS 1961	Honors Elementary Classical Physics I (F)	
PHYS 2021	General Physics I	

PHYS 2921	Honors General Physics I (F)	
Select one of the following:		4
PHYS 1062	Elementary Classical Physics II	
PHYS 1962	Honors Elementary Classical Physics II (S)	
PHYS 2022	General Physics II	
PHYS 2922	Honors General Physics II (S)	
Select two of the following: ¹		3
PHYS 2511	Scientific Computing I	
PHYS 3511	Scientific Computing II	
PHYS 4511	Scientific Computing III	
PHYS 2796	Introduction to Modern Physics (S)	4
PHYS 3702	Optical and Electronic Properties of Materials (F)	4
PHYS 3703	Quantum Materials: Properties, Characterization and Application (S)	4
PHYS 4502	Theoretical/Computational Materials Science	3
Quantum Materials Science Electives		
Select five of the following:		15-18
CHEM 2201 & CHEM 2203	Organic Chemistry I and Organic Chemistry Laboratory I	
CHEM 2921 & CHEM 2923	Organic Chemistry for Honors I and Organic Honors Laboratory I	
CHEM 2202 & CHEM 2204	Organic Chemistry II and Organic Chemistry Laboratory II	
CHEM 2922 & CHEM 2924	Organic Chemistry for Honors II and Organic Honors Laboratory II	
CHEM 3001	Inorganic Chemistry	
CHEM 3301	Physical Chemistry Lecture I	
CHEM 4004	Crystallography and Diffraction	
CHEM 4503	Introduction to Polymer Chemistry ²	
PHYS 3701	Introduction to Quantum Mechanics I ³	
PHYS 4501	Computational Design of Novel and Quantum Materials	
PHYS 4101	Thermal Physics (F)	
PHYS 4302	Optics ⁴	
PHYS 4701	Introduction to Solid State Physics (S, even years) ⁵	
ENGR 2331	Engineering Statics	
ENGR 2333	Mechanics of Solids	
ENGR 3201	Material Science for Engineers	
ENGR 4201	Micro- to Nano-sized Machines	
MEE 4212	Tribology and Surface Engineering	
MEE 5205	Microscopy and Microanalysis of Materials	
Senior Capstone and Research		
3 credits of research in each semester of senior year		
Fall semester of senior year, select one of the following:		3
CHEM 4891	Undergraduate Research	
PHYS 4091	Undergraduate Research	
Spring semester of senior year, select one of the following:		3
CHEM 4891	Undergraduate Research	
PHYS 4091	Undergraduate Research	
Writing Intensive		
SCTC 2396	Writing for Science and Technology	3
Total Credit Hours		76-80

Code	Title	Credit Hours
(F) - Fall only course		
(S) - Spring only course		
1	Students with prior programming experience may be prepared to begin in PHYS 3511. Please see a Physics Faculty Advisor for more information.	
2	CHEM 2202 and CHEM 3301 are prerequisites for this course.	
3	PHYS 2502 is a prerequisite for this course.	
4	CHEM 3301 is a prerequisite for this course.	
5	PHYS 3701 is a prerequisite for this course.	

Suggested Academic Plan

Please note that this is a suggested academic plan. Depending on your situation, your academic plan may look different.

Bachelor of Science in Quantum Materials Science

Suggested Plan for New Students Starting in the 2024-2025 Academic Year

Year 1		Credit Hours
Fall		
MATH 1041 or MATH 1941	Calculus I or Honors Calculus I	4
Select one of the following:		4
PHYS 1061	Elementary Classical Physics I	
PHYS 1961	Honors Elementary Classical Physics I (F)	
PHYS 2021	General Physics I	
PHYS 2921	Honors General Physics I (F)	
SCTC 1001	CST First Year Seminar	1
SCTC 1013	Elements of Data Science for the Physical and Life Sciences	3
ENG 0802 or ENG 0812 or ENG 0902	Analytical Reading and Writing [GW] or Analytical Reading and Writing: ESL [GW] or Honors Analytical Reading and Writing [GW]	4
Credit Hours		16
Spring		
MATH 1042 or MATH 1942	Calculus II or Honors Calculus II	4
Select one of the following:		4
PHYS 1062	Elementary Classical Physics II	
PHYS 1962	Honors Elementary Classical Physics II (S)	
PHYS 2022	General Physics II	
PHYS 2922	Honors General Physics II (S)	
PHYS 2511	Scientific Computing I ¹	1.5
IH 0851 or IH 0951	Intellectual Heritage I: The Good Life [GY] or Honors Intellectual Heritage I: The Good Life [GY]	3
GenEd Breadth Course		3
Credit Hours		15.5
Year 2		
Fall		
Select one of the following:		4
CHEM 1031 & CHEM 1033	General Chemistry I and General Chemistry Laboratory I	
CHEM 1951 & CHEM 1953	Honors General Chemical Science I and Honors Chemical Science Laboratory I	

MATH 2043 or MATH 2943	Calculus III or Honors Calculus III	4
Select one of the following:		3-4
MATH 2041	Differential Equations I	
MATH 2045	Differential Equations with Linear Algebra	
MATH 2941	Honors Differential Equations I	
PHYS 3511	Scientific Computing II	1.5
Elective		3-2
Credit Hours		15.5
Spring		
Select one of the following:		4
CHEM 1032 & CHEM 1034	General Chemistry II and General Chemistry Laboratory II	
CHEM 1952 & CHEM 1954	Honors General Chemical Science II and Honors Chemical Science Laboratory II	
PHYS 2796	Introduction to Modern Physics [WI] (S)	4
GenEd Breadth Course		3
IH 0852 or IH 0952	Intellectual Heritage II: The Common Good [GZ] or Honors Intellectual Heritage II: The Common Good [GZ]	3
Elective		2
Credit Hours		16
Year 3		
Fall		
PHYS 3702	Optical and Electronic Properties of Materials	4
Quantum Materials Science Elective 1 ²		3-4
GenEd Breadth Course		3-4
GenEd Breadth Course		3
Elective		1-0
Credit Hours		14-15
Spring		
PHYS 3703	Quantum Materials: Properties, Characterization and Application	4
SCTC 2396	Writing for Science and Technology [WI]	3
Quantum Materials Science Elective 2 ²		3-4
GenEd Breadth Course		3
Elective		3-1
Credit Hours		16-15
Year 4		
Fall		
PHYS 4502	Theoretical/Computational Materials Science	3
Select one of the following:		3
CHEM 4891	Undergraduate Research	
PHYS 4091	Undergraduate Research	
Quantum Materials Science Elective 3 ²		3-4
Elective		3
Elective		3-2
Credit Hours		15
Spring		
Select one of the following:		3
CHEM 4891	Undergraduate Research	
PHYS 4091	Undergraduate Research	
Quantum Materials Science Elective 4 ²		3
Quantum Materials Science Elective 5 ²		3
Elective		3

Elective	3
Credit Hours	15
Total Credit Hours	123

Code	Title	Credit Hours
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(F) - Fall only course
(S) - Spring only course

¹ Students with prior programming experience may be prepared to begin in PHYS 3511 and complete the Scientific Computing requirement with PHYS 4511. Please see a Physics faculty advisor for more information.
² Select from the Quantum Materials Science Electives list under Requirements.