Materials Science and Technology

Jayson Paulose, Program Director

Materials Science and Technology major will focus on the properties of materials needed for modern technology, and how they relate to the underlying physical and chemical structure.

Materials are the functional components of modern technology - electrodes for rechargeable batteries, semiconductors, conductors, and insulators in electronics for classical and quantum computers, polymers/plastics, sensors, and much more. Materials scientists invent new materials and study the connections between underlying atomic/molecular structure of a material, its properties, its processing methods, and its performance in applications.

Admission

Students will be required to apply for admission into the MSTC major after completing the foundational course sequences in physics (PHYS 201/2/3 or 251/2/3 + lab), chemistry (CH 221/2/3 or 224/5/6H + lab), materials science (MSTC 231/232), and the CH329 Research Immersion course. Students will be asked to provide their academic transcript, their choice of physics or chemistry emphasis, and potential research/industry area of interest as part of the application.

The requirement for admission is achieving a GPA of 3.0 or better in the foundational courses. Students not meeting this requirement, but with a strong academic record that demonstrates steady progress towards acquiring the quantitative and critical thinking skills necessary for success in the program, can petition for admission to the program through additional review. In addition to application materials listed above, applicants will be asked to provide a CV; short essay responses to prompts that aim to evaluate their clarity of purpose and dedication with regard to academic/career goals, ability to overcome obstacles, and ability to tackle open-ended research questions; and references from 1-2 instructors in the foundational courses. Applications will be evaluated by a three-member committee with members drawn from chemistry and physics faculty.

See program's website (https://naturalsciences.uoregon.edu/materials-science-technology/apply/declare-major-minor/) for more details.

Program Administration

Jayson Paulose, Program Director, Physics

Victoria DeRose, Department Head, Chemistry and Biochemistry

Richard Taylor, Department Head, Physics

Advisory Committee

Matthias Agne, Chemistry

Scott Fisher, Physics

Michael Koscho, Chemistry and Biochemistry

Ben McMorran, Physics

Celeste Melamed, Chemistry

Program Learning Outcomes

Upon successful completion of this program, students will be able to:

- Materials Science and Technology majors will be able to connect the atomic and molecular structure of materials to their properties, understanding based on the foundations of physics and chemistry, how to design and test materials for advanced applications in energy, computation, transportation, bioengineering, mechanical applications and more. They will learn and apply modern techniques in data, programming, and computation to solve problems and develop technology specializations that launch their career in industry, national laboratories or academia.

Materials Science and Technology Major Requirements

Courses used to fulfill the major requirements must be taken for a letter grade and passed with a grade of C- or better.

Code	Title	Credits
Foundation courses		
CH 224H–226H	Honors General Chemistry [1]	12
CH 329	Research Immersion Laboratory	3
MSTC 231	Fundamentals of Materials in Technology I	4
MSTC 232	Fundamentals of Materials in Technology II	4
PHYS 251–253	Foundations of Physics I [2]	12
Select one of the lab options:		3-4
Option A:		
PHYS 290	Foundations of Physics Laboratory (Taken three times)	
Option B:		
PHYS 204	Introductory Physics Laboratory	
PHYS 205	Introductory Physics Laboratory	
Option C: [3]		
CH 227Z & CH 217	General Chemistry I Laboratory and Chemistry Tools I	
CH 228Z & CH 218	General Chemistry II Laboratory and Chemistry Tools II	
Mathematics and Computation		
MATH 251Z–253Z	Calculus: Differential, Integral, and Sequences & Series	12
MATH 256	Introduction to Differential Equations	4
MATH 281	Several-Variable Calculus I	4
MATH 341	Elementary Linear Algebra	4
Advanced Math/Computation Elective - select one		4
CS 210	Computer Science I	
or CS 211	Computer Science II	
or CS 212	Computer Science III	
MATH 282	Several-Variable Calculus II	
MATH/PHYS 421M	Partial Differential Equations: Fourier Analysis I	
MATH 422	Partial Differential Equations: Fourier Analysis II	
PHYS 389	Mathematical Methods	
Fundamentals of Materials Science [4]		
Select one of the emphasis (see below)		22-24

Materials Science and Technology Core		
MSTC 431	Thermal Physics of Advanced Materials	4
MSTC 432	Kinetics and Transport in Advanced Materials	4
MSTC 441	Electronic, Optical and Magnetic Properties of Materials I	4
MSTC 442	Electronic, Optical and Magnetic Properties of Materials II	4
Upper-Division Electives		
Three upper-division or graduate level materials science, chemistry, or physic courses on top of the courses outlined above. Courses are expected to be 400-level or above.		12
Total Credits		**116-119**

1 Students can petition to count CH221Z-223Z instead.
2 Students can petition to count PHYS 201-203 instead.
3 Students who transfer CH 227/228 credits from other schools may be waived corresponding CH 217/218.
4 Students are expected to follow the physics or chemistry emphasis; courses from different emphasis may be mixed by petition as long as all categories/prerequisites are fulfilled.

Physics Emphasis

Code	Title	Credits
PHYS 351	Foundations of Physics II	4
PHYS 352	Thermal Physics and Statistical Mechanics I	4
PHYS 353	Thermal Physics and Statistical Mechanics II	4
CH 341	Majors Track Organic Chemistry I [1]	4
Advanced Lab Courses - select two of the following: [2]		8
DSCI 101	Foundations of Data Science I	
PHYS 391	Physics Experimentation Data Analysis Laboratory	
PHYS 431	Analog Electronics	
PHYS 432	Digital Electronics	
PHYS 481	Design of Experiments	
Total Credits		**24**

1 CH 331 may be substituted.
2 The requirement of Advanced Lab credits may be partially met by undergraduate research credits (PHYS 401, PHYS 491, PHYS 492, PHYS 493, CH 401) instead of courses listed.

Chemistry Emphasis

Code	Title	Credits
CH 341	Majors Track Organic Chemistry I [1]	4
CH 411	Physical Chemistry	4
Select one of the Advanced Chemistry Sequence		**8**
Organic Chemistry [2]		
CH 342	Majors Track Organic Chemistry II	
CH 343	Majors Track Organic Chemistry III	
Physical Chemistry		
CH 412	Physical Chemistry	
CH 413	Physical Chemistry	
Select one of the Advanced Lab Sequence [3]		**6-8**
Organic Chemistry Lab Sequence [4]		
CH 347	Majors Organic Chemistry Laboratory I	
CH 348	Organic Chemistry Laboratory for Majors	
Physical Chemistry Lab Sequence		
CH 417	Physical Chemistry Laboratory	
CH 418	Physical Chemistry Laboratory	
Total Credits		**22-24**

1 CH 331 may be substituted.
2 CH 335/CH 336 may be substituted.
3 The requirement of Advanced Lab credits may be partially met by undergraduate research credits (PHYS 401, PHYS 491, PHYS 492, PHYS 493, CH 401) instead of courses listed.
4 CH 337/CH 338 may be substituted.

Four-Year Degree Plan

The degree plan shown is only a sample of how students may complete their degrees in four years. There are alternative ways. Students should consult their advisor to determine the best path for them.

Bachelor of Science in Materials Science and Technology (Physics Emphasis)

Course	Title	Credits Milestones
First Year		
Fall		
CH 111	Introduction to Chemical Principles	4
MATH 111Z	Precalculus I: Functions	4
WR 121Z	Composition I	4
Core Ed		4
	Credits	**16**
Winter		
CH 221Z	General Chemistry I	4
MATH 112Z	Precalculus II: Trigonometry	4
WR 122Z	Composition II	4
Core Ed		4
	Credits	**16**
Spring		
CH 222Z	General Chemistry II	4
MATH 251Z	Differential Calculus	4
DSCI 101	Foundations of Data Science I	4
Core Ed		4
	Credits	**16**
Second Year		
Fall		
CH 223Z	General Chemistry III	4
PHYS 251	Foundations of Physics I	4
PHYS 290	Foundations of Physics Laboratory	1
MSTC 231	Fundamentals of Materials in Technology I	4
Core Ed		4
	Credits	**17**

Winter		
MATH 252Z	Integral Calculus	4
PHYS 252	Foundations of Physics I	4
PHYS 290	Foundations of Physics Laboratory	1
MSTC 232	Fundamentals of Materials in Technology II	4
Core Ed		4
	Credits	**17**
Spring		
MATH 253Z	Calculus: Sequences and Series	4
PHYS 253	Foundations of Physics I	4
PHYS 290	Foundations of Physics Laboratory	1
CH 329	Research Immersion Laboratory	3
Core Ed		4
	Credits	**16**
Third Year		
Fall		
PHYS 351	Foundations of Physics II	4
CH 341	Majors Track Organic Chemistry I	4
MATH 256	Introduction to Differential Equations	4
Core Ed		4
	Credits	**16**
Winter		
PHYS 352	Thermal Physics and Statistical Mechanics I	4
PHYS 391	Physics Experimentation Data Analysis Laboratory	4
MATH 281	Several-Variable Calculus I	4
Core Ed		4
	Credits	**16**
Spring		
PHYS 353	Thermal Physics and Statistical Mechanics II	4
MATH 341	Elementary Linear Algebra	4
Core Ed		4
Electives		2
	Credits	**14**
Fourth Year		
Fall		
MSTC 431	Thermal Physics of Advanced Materials	4
MATH 282	Several-Variable Calculus II	4
UD Elective for MSTC major		4
	Credits	**12**
Winter		
MSTC 441	Electronic, Optical and Magnetic Properties of Materials I	4
UD Elective for MSTC major		4
Core Ed		4
	Credits	**12**
Spring		
MSTC 432	Kinetics and Transport in Advanced Materials	4
MSTC 442	Electronic, Optical and Magnetic Properties of Materials II	4
UD Elective for MSTC major		4
	Credits	**12**
	Total Credits	**180**