College of Natural Science
Department of Chemistry
Undergraduate Programs

Chemical Physics- Bachelor of Science

The major in Chemical Physics provides a strong foundation in chemistry, physics and mathematics for those students who have a professional interest in the areas of overlap between chemistry and physics. It is particularly suitable for students planning to pursue a graduate degree in the area of chemical physics or physical chemistry.

A detailed description of this program may be obtained from the Department of Chemistry.

Requirements for the Bachelor of Science Degree in Chemical Physics

1. The University requirements for bachelor's degrees as described in the *Undergraduate Education* section of this catalog; 120 credits, including general elective credits, are required for the Bachelor of Science degree in Chemical Physics.

   The University's Tier II writing requirement for the Chemical Physics major is met by completing two enrollments of Chemistry 499. That course is referenced in item 3. b. (6) below.

   Students who are enrolled in the College of Natural Science may complete the alternative track to Integrative Studies in Biological and Physical Sciences that is described in item 1. under the heading Graduation Requirements in the College statement. Certain courses referenced in requirement 3. below may be used to satisfy the alternative track.

2. The requirements of the College of Natural Science for the Bachelor of Science degree.
   The credits earned in certain courses referenced in requirement 3. below may be counted toward College requirements as appropriate.

3. The following requirements for the major:

a. The following courses outside the Department of Chemistry (51 to 60 credits):

(1) One of the following courses (3 to 5 credits):

BS	161	Cell and Molecular Biology	3
BS	162	Organismal and Population Biology	3
BS	181H	Honors Cell and Molecular Biology	3
BS	182H	Honors Organismal and Population Biology	3
ENT	205	Pests, Society and Environment	3
IBIO	150	Integrating Biology: From DNA to Populations	3
LB	144	Biology I: Organismal Biology	4
LB	145	Biology II: Cellular and Molecular Biology	5
MMG	141	Introductory Human Genetics	3
MMG	201	Fundamentals to Microbiology	3
PLB	105	Plant Biology	3
PSL	250	Introductory Physiology	4

(2) The following course (4 credits):

CMSE	201	Computational Modeling and Data Analysis I	4

(3) One of the following courses (3 or 4 credits):

LB	118	Calculus I	4
MTH	132	Calculus I	3
MTH	152H	Honors Calculus I	3

(4) One of the following courses (4 credits):

LB	119	Calculus II	4
MTH	133	Calculus II	4
MTH	153H	Honors Calculus II	4

(5) One of the following courses (4 credits):

LB	220	Calculus III	4

	MTH	234	Multivariable Calculus		4
	MTH	254H	Honors Multivariable Calculus		4
(6)	One of the following courses (3 credits):				
	MTH	235	Differential Equations		3
	MTH	340	Ordinary Differential Equations I		3
	MTH	347H	Honors Ordinary Differential Equations		3
(7)	One of the following sets of courses (4 to 7 credits):				
	(a)	MTH	299	Transitions	4
		MTH	309	Linear Algebra I	3
	(b)	MTH	299	Transitions	4
		MTH	314	Matrix Algebra with Computational Applications	3
	(c)	MTH	317H	Honors Linear Algebra	4
(8)	One of the following courses (3 credits):				
	MTH	310	Abstract Algebra I and Number Theory		3
	MTH	320	Analysis I		3
	MTH	327H	Honors Introduction to Analysis		3
	MTH	415	Applied Linear Algebra		3
	MTH	418H	Honors Algebra I		3
	MTH	441	Ordinary Differential Equations II		3
	MTH	442	Partial Differential Equations		3
	MTH	451	Numerical Analysis I		3
(9)	One of the following groups of courses (8 or 10 credits):				
	(a)	PHY	183	Physics for Scientists and Engineers I	4
		PHY	184	Physics for Scientists and Engineers II	4
		PHY	191	Physics Laboratory for Scientists I	1
		PHY	192	Physics Laboratory for Scientists II	1

	(b)	PHY	191	Physics Laboratory for Scientists I	1
		PHY	192	Physics Laboratory for Scientists II	1
		PHY	193H	Honors Physics I - Mechanics	4
		PHY	294H	Honors Physics II - Electromagnetism	4
	(c)	LB	273	Physics I	4
		LB	274	Physics II	4
	(d)	PHY	173	Studio Physics for Scientists and Engineers I	5
		PHY	174	Studio Physics for Scientists and Engineers II	5
(10)	All of the following courses (12 credits):				
	PHY	215		Thermodynamics and Modern Physics	3
	PHY	321		Classical Mechanics I	3
	PHY	471		Quantum Physics I	3
	PHY	481		Electricity and Magnetism I	3
(11)	One of the following courses (3 or 4 credits):				
	PHY	410		Thermal and Statistical Physics	3
	PHY	415		Methods of Theoretical Physics	4
	PHY	422		Classical Mechanics II	3
	PHY	431		Optics I	3
	PHY	472		Quantum Physics II	3
	PHY	480		Computational Physics	3
	PHY	482		Electricity and Magnetism II	3
	PHY	491		Introduction to Condensed Matter Physics	3
	PHY	492		Introduction to Nuclear Physics	3
	PHY	493		Introduction to Elementary Particle Physics	3
b.	The following courses in the Department of Chemistry (29 to 31 credits):				
(1)	One of the following pairs of courses (7 or 8 credits):				

	(a)	CEM	151	General and Descriptive Chemistry	4
		CEM	152	Principles of Chemistry	3
	(b)	CEM	181H	Honors Chemistry I	4
		CEM	182H	Honors Chemistry II	4
	(c)	LB	171	Principles of Chemistry I	4
		LB	172	Principles of Chemistry II	3
(2)	One of the following groups of courses (5 credits):				
	(a)	CEM	161	Chemistry Laboratory I	1
		CEM	162	Chemistry Laboratory II	1
		CEM	262	Quantitative Analysis	3
	(b)	CEM	185H	Honors Chemistry Laboratory I	2
		CEM	262	Quantitative Analysis	3
	(c)	CEM	262	Quantitative Analysis	3
		LB	171L	Introductory Chemistry Laboratory I	1
		LB	172L	Principles of Chemistry II - Reactivity Laboratory	1
(3)	One of the following pairs of courses (6 credits):				
	(a)	CEM	251	Organic Chemistry I	3
		CEM	252	Organic Chemistry II	3
	(b)	CEM	351	Organic Chemistry I	3
		CEM	352	Organic Chemistry II	3
(4)	One of the following courses (2 or 3 credits):				
		CEM	333	Instrumental Methods and Applications	3
		CEM	395	Analytical/Physical Laboratory	2
		CEM	495	Molecular Spectroscopy	3
(5)	All of the following courses (7 credits):				
		CEM	444	Chemical Safety	1

	CEM	483	Quantum Chemistry	3
	CEM	484	Molecular Thermodynamics	3
(6)	The following capstone course (2 credits):			
	CEM	499	Chemical Physics Seminar	2
	The completion of Chemistry 499 fulfills the department's capstone requirement. Two enrollments in Chemistry 499 are required, 1 credit per enrollment.			

BS in Chemical Physics - Sample Schedule

	Fall Semester	Spring Semester	Credits[1]
Year 1	CEM 151 (4) or CEM 181H (4) CEM 161 (1) or CEM 185H (2)[2] MTH 132 (3) WRA 101 Tier I Writing (4)[3] Elective or UR[4] (3 or 4)	CEM 152 (3) or CEM 182H (4) CEM 162 (1)[2] MTH 133 (4) MTH 299 (4) Elective or UR[4] (3 or 4)	30-32
Year 2	CEM 351 (3) or CEM 251 (3) CEM 262 (3)[5] MTH 234 (4) PHY 183 (4) PHY 191 (1)	CEM 352 (3) or CEM 252 (3) MTH 235 (3) PHY 184 (4) PHY 192 (1) Elective or UR[4] (3 or 4)	29-30
Year 3	CEM 483 (3) MTH 309 (3) or MTH 314 (3)[6] PHY 215 (3) CMSE 201 (4) CEM 444 (1)	CEM 484 (3) CEM 499 (1)[7] CEM 333 (3) or CEM 395 (2)[8] PHY 321 (3) BS 161 (3)[9] [Elective, UR[4] and CEM 400H/420 (1-3)[10]] (3-4)	30-31
Year 4	PHY 471 (3) PHY 481 (3) Advanced MTH[11] or PHY[12] elective (3) [Electives, UR[4] and CEM 400H/420 (1-3)[10]] (6-7)	CEM 499 (1)[7] Advanced MTH11 or PHY12 elective (3) [Electives, UR[4] and CEM 400H/420 (1-3)[10]] (11-12)	30 -32

[1]A total of at least 120 credits is required for graduation.

[2]Chemical Physics majors are required to take either (CEM 161 and CEM 162) or CEM 185H.

[3]A score of 4 or 5 on an AP English exam will receive credit for WRA 101 (4). A score of 3 will not earn credit, but WRA 101 will be waived. Students who have satisfied the Tier I writing requirement through Advanced Placement could substitute an elective or a course to fulfill a University requirement.

[4]UR = University Requirement [University General Education Requirements: WRA Tier I writing course (4) in Year 1; IAH course below 211 (4), which has a Tier I writing course as a prerequisite; IAH course above 211 (4); ISS 200-level (4); ISS 300-level (4)]

[5]CEM 262 is an explicit prerequisite for CEM 333 and CEM 395. It is an implicit prerequisite for the other advanced chemistry lab options. All Chemical Physics majors are required to take CEM 262.

[6]CMSE 201 is a prerequisite for MTH 314. If CMSE 201 is taken before fall of third year, MTH 314 could be taken during this semester. Enrollment in MTH 314 could also be delayed until spring of third year.

[7]Students must enroll in CEM 499 twice. It is only offered in spring semesters.

[8]This requirement can also be satisfied by CEM 495 (2) in fall semester of Year 4.

[9]BS 161 Cell and Molecular Biology has CEM 151 or CEM 181H as a prerequisite. There are other options for fulfilling the alternative track Biological Sciences requirement (BS 162, BS 181H, BS 182H, ENT 205, IBIO 150, LB 144, LB 145, MMG 141, MMG 201, PLB 105, PSL 250).

[10]Students are encouraged to include undergraduate research (CEM 420 or CEM 400H) in their electives. Maximum of 12 credits in CEM 400H/420 are permitted.

[11]Advanced MTH = One of the following: MTH 310, 320, 327H, 415, 418H, 441, 442, 451.

[12]Advanced PHY = One of the following: PHY 410, 415, 422, 431, 472, 480, 482, 491, 492, 493.

Version: 1/25/24 – SO-CV

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Department of Chemistry Website Academic Programs:

https://www.chemistry.msu.edu/undergraduate-program/academic-programs.aspx

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