

# PHYSICS - B.S.

## College of Arts and Sciences

Department of Physics

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Kent Campus

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## Description

The Bachelor of Science degree in Physics is a professionally oriented program that serves as preparation either for graduate work in physics or for entrance into positions in a variety of industries or government service.

The Physics major comprises the following concentrations:

- The **Applied Physics** concentration prepares students for immediate entry into careers in industry. Course requirements include electronics, introduction to computer programming, and data analysis and computational physics techniques. While rooted in the basic principles of physics, this program is optimized for students concerned with the application of physics in practical devices and systems.
- The **Biological Sciences** concentration is interdisciplinary and for students with a strong interest in both physics and biology, who may wish to prepare for graduate study in biophysics or for work in a biotechnology company.
- The **Chemistry** concentration is interdisciplinary and designed for students with a strong interest in both physics and chemistry, who may wish to prepare for graduate study in chemical physics or for work in a high-technology materials-related research and development laboratory.
- The **Computer Science** concentration is interdisciplinary and provides a foundation in physics while emphasizing the use of computer software in scientific applications. Graduates are prepared for computer-related careers that require an understanding of the underlying science as well as knowledge of relevant computer applications.
- The **Entrepreneurship** concentration is interdisciplinary and designed to prepare physics majors for various aspects of starting or managing a scientific business.
- The **Mathematical Physics** concentration is interdisciplinary and provides students with a strong understanding of applied physical theory, its applications and the underlying mathematics. This training, valuable for start-up positions with a number of industries, may also serve as preparation for graduate work in either physics or mathematics.
- The **Pre-Medicine/Pre-Osteopathy** concentration is interdisciplinary and designed to prepare physics majors for further study leading to careers in medicine.
- The **Research** concentration prepares majors for further study at the graduate level. This program trains students in logical thinking and problem solving using both analytical and computational methods. It also furnishes students with a comprehensive understanding of the basic laws and principles that govern the physical world. Academic assessment and GRE scores keep the program up-to-date

via curricular revisions. This program is a popular stepping stone to graduate degrees not only in physics, but also in engineering, astronomy/astrophysics and materials science.

## Fully Offered At:

- Kent Campus

## Admission Requirements

The university affirmatively strives to provide educational opportunities and access to students with varied backgrounds, those with special talents and adult students who graduated from high school three or more years ago.

**Freshman Students on the Kent Campus:** The freshman admission policy on the Kent Campus is selective. Admission decisions are based upon the following: cumulative grade point average, ACT and/or SAT scores, strength of high school college preparatory curriculum and grade trends. The Admissions Office at the Kent Campus may defer the admission of students who do not meet admissions criteria but who demonstrate areas of promise for successful college study. Deferred applicants may begin their college coursework at one of seven regional campuses of Kent State University. For more information on admissions, including additional requirements for some academic programs, visit the admissions website for new freshmen.

**Freshman Students on the Regional Campuses:** Kent State campuses at Ashtabula, East Liverpool, Geauga, Salem, Stark, Trumbull and Tuscarawas, as well as the Regional Academic Center in Twinsburg, have open enrollment admission for students who hold a high school diploma, GED or equivalent.

**English Language Proficiency Requirements for International Students:** All international students must provide proof of English language proficiency (unless they meet specific exceptions) by earning a minimum 525 TOEFL score (71 on the Internet-based version), minimum 75 MELAB score, minimum 6.0 IELTS score or minimum 48 PTE score, or by completing the ESL level 112 Intensive Program. For more information on international admission, visit the Office of Global Education's admission website.

**Transfer, Transitioning and Former Students:** For more information about admission criteria for transfer, transitioning and former students, please visit the admissions website.

## Program Learning Outcomes

Graduates of this program will be able to:

1. Demonstrate technical and cognitive skills important in a good physicist, including the following:
  - a. Think critically and analytically.
  - b. Define a problem and how to solve problems.
  - c. Understand advanced mathematics (e.g., calculus and differential equations) and computer skills.
  - d. Use, design and even build lab equipment.
2. Demonstrate the traits important in a good scientist, namely, hard working, creative, meticulous, persistence, tenacious and self confidence.

3. Communicate results of their work to peers, to their instructors or supervisors, to various target groups within the physics community and to people outside the discipline.

## University Requirements

All students in a bachelor's degree program at Kent State University must complete the following university requirements for graduation.

**NOTE:** University requirements may be fulfilled in this program by specific course requirements. Please see Program Requirements for details.

Destination Kent State: First Year Experience	1
Course is not required for students with 25 transfer credits, excluding College Credit Plus, or age 21+ at time of admission.	
Diversity Domestic/Global (DIVD/DIVG)	2 courses
Students must successfully complete one domestic and one global course, of which one must be from the Kent Core.	
Experiential Learning Requirement (ELR)	varies
Students must successfully complete one course or approved experience.	
Kent Core (see table below)	36-37
Writing-Intensive Course (WIC)	1 course
Students must earn a minimum C grade in the course.	
Upper-Division Requirement	39 (or 42)
Students must successfully complete 39 upper-division (numbered 30000 to 49999) credit hours to graduate. Students in a B.A. and/or B.S. degree in the College of Arts and Sciences must complete 42 upper-division credit hours.	
Total Credit Hour Requirement	120
Some bachelor's degrees require students to complete more than 120 credit hours.	

## Kent Core Requirements

Kent Core Composition (KCMP)	6
Kent Core Mathematics and Critical Reasoning (KMCR)	3
Kent Core Humanities and Fine Arts (KHUM/KFA) (min one course each)	9
Kent Core Social Sciences (KSS) (must be from two disciplines)	6
Kent Core Basic Sciences (KBS/KLAB) (must include one laboratory)	6-7
Kent Core Additional (KADL)	6
<b>Total Credit Hours:</b>	<b>36-37</b>

## Program Requirements

### Major Requirements

Code	Title	Credit Hours
<b>Major Requirements (courses count in major GPA)</b>		
CHEM 10060	GENERAL CHEMISTRY I (KBS)	4
CHEM 10061	GENERAL CHEMISTRY II (KBS)	4
CHEM 10062	GENERAL CHEMISTRY I LABORATORY (KBS) (KLAB)	1
CHEM 10063	GENERAL CHEMISTRY II LABORATORY (KBS) (KLAB)	1
MATH 12002	ANALYTIC GEOMETRY AND CALCULUS I (KMCR)	5
MATH 12003	ANALYTIC GEOMETRY AND CALCULUS II	5

MATH 32051	MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES I	4
MATH 32052	MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES II	4
PHY 12000	INTRODUCTORY PHYSICS SEMINAR (ELR)	1
PHY 23101	GENERAL UNIVERSITY PHYSICS I (KBS) (KLAB) <sup>1</sup>	5
PHY 23102	GENERAL UNIVERSITY PHYSICS II (KBS) (KLAB) <sup>1</sup>	5
PHY 30020	INTERMEDIATE PHYSICS LABORATORY (WIC) <sup>2</sup>	2
PHY 35101	CLASSICAL MECHANICS	4
PHY 36001	INTRODUCTORY MODERN PHYSICS	3
PHY 40020	ADVANCED PHYSICS LABORATORY (WIC) <sup>2</sup>	2
PHY 40092	INTERNSHIP IN PHYSICS (ELR) <sup>3</sup>	2
PHY 45201	ELECTROMAGNETIC THEORY	4

### Additional Requirements (courses do not count in major GPA)

UC 10097	DESTINATION KENT STATE: FIRST YEAR EXPERIENCE	1
Foreign Language (see Foreign Language College Requirement below)		8
Kent Core Composition		6
Kent Core Humanities and Fine Arts <sup>4</sup>		9

### Concentrations

Choose from the following:	40
Applied Physics	
Biological Sciences	
Chemistry	
Computer Science	
Entrepreneurship	
Mathematical Physics	
Pre-Medicine/Pre-Osteopathy	
Research	

Minimum Total Credit Hours: 120

- Credit is not granted for both the PHY 13001/PHY 13002 and the PHY 23101/PHY 23102 series, nor for the PHY 13011/PHY 13012 series.
- A minimum C grade must be earned to fulfill the writing-intensive requirement.
- With advisor's permission. PHY 40092 may be replaced with PHY 40096 or PHY 40099. If PHY 40096 is taken, a suitable research project should be selected.
- PHIL 21001 is highly recommended to fulfill the Kent Core Humanities category for the Pre-Medicine/Pre-Osteopathy concentration. This course also fulfills the global diversity requirement.

## Applied Physics Concentration Requirements

Code	Title	Credit Hours
<b>Concentration Requirements (courses count in major GPA)</b>		
CS 13011 & CS 13012	COMPUTER SCIENCE IA: PROCEDURAL PROGRAMMING and COMPUTER SCIENCE IB: OBJECT ORIENTED PROGRAMMING	4
or CS 13001	COMPUTER SCIENCE I: PROGRAMMING AND PROBLEM SOLVING	
PHY 22564	INTRODUCTION TO MATERIALS PHYSICS	3
PHY 32511	ELECTRONICS	4
PHY 36002	APPLICATIONS OF MODERN PHYSICS	3

PHY 45403	DATA ANALYSIS AND COMPUTATIONAL PHYSICS TECHNIQUES	3
PHY 45501	ELECTROMAGNETIC WAVES AND MODERN OPTICS	3
Physics (PHY) Elective		
Physics (PHY) Upper-Division Elective (30000 or 40000 level)		
<b>Additional Requirements (courses do not count in major GPA)</b>		
Kent Core Social Sciences (must be from two disciplines)		
General Elective (total credit hours depends on earning 120 credit hours, including 42 upper-division credit hours)		
Minimum Total Credit Hours:		40

## Biological Sciences Concentration Requirements

Code	Title	Credit Hours
<b>Concentration Requirements (courses count in major GPA)</b>		
BSCI 10110	BIOLOGICAL DIVERSITY (KBS) (KLAB)	4
BSCI 10120	BIOLOGICAL FOUNDATIONS (KBS) (KLAB)	4
BSCI 30140	CELL BIOLOGY	4
BSCI 30156	ELEMENTS OF GENETICS	3
BSCI 40163	EVOLUTION	3
PHY 45301	THERMAL PHYSICS	3
PHY 46101	QUANTUM MECHANICS	4
Major Upper-Division Elective <sup>1</sup>		
<b>Additional Requirements (courses do not count in major GPA)</b>		
Kent Core Social Sciences (must be from two disciplines)		
General Elective (total credit hours depends on earning 120 credit hours, including 42 upper-division credit hours)		
Minimum Total Credit Hours:		40

<sup>1</sup> Recommended major electives: BSCI 40158, CHEM 30481, PHY 41010, PHY 44600.

## Chemistry Concentration Requirements

Code	Title	Credit Hours
<b>Concentration Requirements (courses count in major GPA)</b>		
CHEM 30481	ORGANIC CHEMISTRY I <sup>1</sup>	3
CHEM 30482	ORGANIC CHEMISTRY II	3
CHEM 30105	ANALYTICAL CHEMISTRY I	3
CHEM 30107	ANALYTICAL CHEMISTRY LABORATORY I (WIC)	1
CHEM 30301	INORGANIC CHEMISTRY I	2
PHY 36002	APPLICATIONS OF MODERN PHYSICS	3
PHY 45301	THERMAL PHYSICS	3
PHY 46101	QUANTUM MECHANICS	4
Physics (PHY) Electives		
<b>Additional Requirements (courses do not count in major GPA)</b>		
Kent Core Social Sciences (must be from two disciplines)		
General Elective (total credit hours depends on earning 120 credit hours, including 42 upper-division credit hours)		
Minimum Total Credit Hours:		40

<sup>1</sup> Students who have already completed CHEM 30481 and CHEM 30482 may not take and apply CHEM 20482 toward the program.

## Computer Science Concentration Requirements

Code	Title	Credit Hours
<b>Concentration Requirements (courses count in major GPA)</b>		
CS 13011 & CS 13012	COMPUTER SCIENCE IA: PROCEDURAL PROGRAMMING and COMPUTER SCIENCE IB: OBJECT ORIENTED PROGRAMMING	4
or CS 13001	COMPUTER SCIENCE I: PROGRAMMING AND PROBLEM SOLVING	
CS 23001	COMPUTER SCIENCE II: DATA STRUCTURES AND ABSTRACTION	4
CS 23022	DISCRETE STRUCTURES FOR COMPUTER SCIENCE	3
CS 42201	INTRODUCTION TO NUMERICAL COMPUTING I	3
PHY 36002	APPLICATIONS OF MODERN PHYSICS	3
PHY 46101	QUANTUM MECHANICS	4
Physics (PHY) Upper-Division Electives (30000 or 40000 level)		
<b>Additional Requirements (courses do not count in major GPA)</b>		
Kent Core Social Sciences (must be from two disciplines)		
General Elective (total credit hours depends on earning 120 credit hours, including 42 upper-division credit hours)		
Minimum Total Credit Hours:		40

## Entrepreneurship Concentration Requirements

Code	Title	Credit Hours
<b>Concentration Requirements (courses count in major GPA)</b>		
ACCT 23020	INTRODUCTION TO FINANCIAL ACCOUNTING	3
or ENTR 37040	ENTREPRENEURIAL TOOLS	
ECON 22060	PRINCIPLES OF MICROECONOMICS (KSS)	3
ENTR 27056	INTRODUCTION TO ENTREPRENEURSHIP	3
ENTR 27466	SPEAKER SERIES IN ENTREPRENEURSHIP	1
ENTR 37065	ENTREPRENEURIAL FINANCE	3
MKTG 25010	PRINCIPLES OF MARKETING	3
Physics (PHY) Upper-Division Elective (30000 or 40000 level)		
<b>Additional Requirements (courses do not count in major GPA)</b>		
Kent Core Social Sciences (must be from two disciplines)		
General Elective (total credit hours depends on earning 120 credit hours, including 42 upper-division credit hours) <sup>1</sup>		

<sup>1</sup> Recommended General Electives: ENTR 47047, and one of the following: ENTR 37045, ENTR 37075, MKTG 35056.

## Mathematical Physics Concentration Requirements

Code	Title	Credit Hours
<b>Concentration Requirements (courses count in major GPA)</b>		
CS 13011 & CS 13012	COMPUTER SCIENCE IA: PROCEDURAL PROGRAMMING and COMPUTER SCIENCE IB: OBJECT ORIENTED PROGRAMMING	4
or CS 13001	COMPUTER SCIENCE I: PROGRAMMING AND PROBLEM SOLVING	
PHY 36002	APPLICATIONS OF MODERN PHYSICS	3
PHY 45401	MATHEMATICAL METHODS IN PHYSICS	4
PHY 45403	DATA ANALYSIS AND COMPUTATIONAL PHYSICS TECHNIQUES	3
PHY 46101	QUANTUM MECHANICS	4

Physics (PHY) Electives	9	General Elective (total credit hours depends on earning 120 credit hours, including 42 upper-division credit hours)	8
<b>Additional Requirements (courses do not count in major GPA)</b>			
Kent Core Social Sciences (must be from two disciplines)	6	Minimum Total Credit Hours:	40
General Elective (total credit hours depends on earning 120 credit hours, including 42 upper-division credit hours)	7		
Minimum Total Credit Hours:	40		

## Pre-Medicine/Pre-Osteopathy Concentration Requirements

Code	Title	Credit Hours
<b>Concentration Requirements (courses count in major GPA)</b>		
BSCI 10120	BIOLOGICAL FOUNDATIONS (KBS) (KLAB)	4
BSCI 30130	HUMAN PHYSIOLOGY	3
or BSCI 40430	ANIMAL PHYSIOLOGY	
BSCI 30140	CELL BIOLOGY	4
BSCI 30156	ELEMENTS OF GENETICS	3
BSCI 30171	GENERAL MICROBIOLOGY	4
CHEM 30284	INTRODUCTORY BIOLOGICAL CHEMISTRY	4
or CHEM 40245	BIOCHEMICAL FOUNDATIONS OF MEDICINE	
CHEM 30475	ORGANIC CHEMISTRY LABORATORY I (ELR)	1
CHEM 30476	ORGANIC CHEMISTRY LABORATORY II	1
CHEM 30481	ORGANIC CHEMISTRY I	3
CHEM 30482	ORGANIC CHEMISTRY II	3
PSYC 11762	GENERAL PSYCHOLOGY (DIVD) (KSS)	3
SOC 12050	INTRODUCTION TO SOCIOLOGY (DIVD) (KSS)	3
Concentration Elective, choose from the following:		3-4
BSCI 30518	VERTEBRATE ANATOMY	
BSCI 40174	IMMUNOLOGY	
BSCI 40517	MEDICAL HISTOLOGY	
PHY 41010	BIOPHOTONICS	
PHY 44600	INTRODUCTION TO BIOLOGICAL PHYSICS	
<b>Additional Requirements (courses do not count in major GPA)</b>		
General Elective (total credit hours depends on earning 120 credit hours, including 42 upper-division credit hours)		1
Minimum Total Credit Hours:		40

## Research Concentration Requirements

Code	Title	Credit Hours
<b>Concentration Requirements (courses count in major GPA)</b>		
CS 13011 & CS 13012	COMPUTER SCIENCE IA: PROCEDURAL PROGRAMMING and COMPUTER SCIENCE IB: OBJECT ORIENTED PROGRAMMING	4
or CS 13001	COMPUTER SCIENCE I: PROGRAMMING AND PROBLEM SOLVING	
PHY 36002	APPLICATIONS OF MODERN PHYSICS	3
PHY 45301	THERMAL PHYSICS	3
PHY 45403	DATA ANALYSIS AND COMPUTATIONAL PHYSICS TECHNIQUES	3
PHY 46101	QUANTUM MECHANICS	4
Physics (PHY) Electives		5
Physics (PHY) Upper-Division Electives (30000 or 40000 level)		4
<b>Additional Requirements (courses do not count in major GPA)</b>		
Kent Core Social Sciences (must be from two disciplines)		6

## Graduation Requirements

Minimum Major GPA	Minimum Overall GPA
2.000	2.000

- The following courses may not count towards the Physics major requirements: PHY 11030, PHY 21040, PHY 21041, PHY 21430 and PHY 21431.

### Foreign Language College Requirement

- Students pursuing the Bachelor of Science degree in the College of Arts and Sciences must complete 8 credit hours of foreign language.<sup>1</sup>
- Minimum Elementary I and II of the same language

<sup>1</sup> All students with prior foreign language experience should take the foreign language placement test to determine the appropriate level at which to start. Some students may begin their university foreign language experience beyond the Elementary I level and will complete the requirement with fewer credit hours and fewer courses. This may be accomplished by: (1) passing a course beyond the Elementary I through Intermediate II level or (2) receiving credit through Credit by Exam (CBE), the College Level Examination Program (CLEP), the Advanced Placement (AP) exam or credit through the International Baccalaureate (IB) program; or (3) being designated a "native speaker" of a non-English language (consult with the College of Arts and Sciences Advising Office for additional information). When students complete the requirement with fewer than 8 credit hours and two courses, they will complete the remaining hours with general electives.

## Roadmaps

- Applied Physics Concentration
- Biological Sciences Concentration
- Chemistry Concentration
- Computer Science Concentration
- Entrepreneurship Concentration
- Mathematical Physics Concentration
- Pre-Medicine/Pre-Osteopathy Concentration
- Research Concentration

### Applied Physics Concentration

This roadmap is a recommended semester-by-semester plan of study for this major. However, courses designated as critical (!) must be completed in the semester listed to ensure a timely graduation.

Semester One		Credits
!	MATH 12002 ANALYTIC GEOMETRY AND CALCULUS I (KMCR)	5
!	PHY 12000 INTRODUCTORY PHYSICS SEMINAR (ELR)	1
!	PHY 23101 GENERAL UNIVERSITY PHYSICS I (KBS) (KLAB)	5
	UC 10097 DESTINATION KENT STATE: FIRST YEAR EXPERIENCE	1
	Kent Core Requirement	3
Credit Hours		15
Semester Two		Credits
!	MATH 12003 ANALYTIC GEOMETRY AND CALCULUS II	5
!	PHY 23102 GENERAL UNIVERSITY PHYSICS II (KBS) (KLAB)	5
	Kent Core Requirement	3
	Kent Core Requirement	3
Credit Hours		16
Semester Three		Credits
!	CHEM 10060 GENERAL CHEMISTRY I (KBS)	4
!	CHEM 10062 GENERAL CHEMISTRY I LABORATORY (KBS) (KLAB)	1
!	MATH 32051 MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES I	4
	Foreign Language	4
	Kent Core Requirement	3
Credit Hours		16
Semester Four		Credits
!	CHEM 10061 GENERAL CHEMISTRY II (KBS)	4
!	CHEM 10063 GENERAL CHEMISTRY II LABORATORY (KBS) (KLAB)	1
!	MATH 32052 MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES II	4
!	PHY 36001 INTRODUCTORY MODERN PHYSICS	3
	Foreign Language	4
Credit Hours		16
Semester Five		Credits
!	CS 13011 COMPUTER SCIENCE IA: PROCEDURAL PROGRAMMING & CS 13012 or CS 13001 and COMPUTER SCIENCE IB: OBJECT ORIENTED PROGRAMMING or COMPUTER SCIENCE I: PROGRAMMING AND PROBLEM SOLVING	4
!	PHY 35101 CLASSICAL MECHANICS	4
!	PHY 36002 APPLICATIONS OF MODERN PHYSICS	3

!	PHY 45201 ELECTROMAGNETIC THEORY	4
Credit Hours		15
Semester Six		Credits
!	PHY 22564 INTRODUCTION TO MATERIALS PHYSICS	3
!	PHY 30020 INTERMEDIATE PHYSICS LABORATORY (WIC)	2
!	PHY 45403 DATA ANALYSIS AND COMPUTATIONAL PHYSICS TECHNIQUES	3
	Physics (PHY) Elective	3
	Kent Core Requirement	3
Credit Hours		14
Semester Seven		Credits
!	PHY 32511 ELECTRONICS	4
!	PHY 40092 INTERNSHIP IN PHYSICS (ELR)	2
	Kent Core Requirement	3
	Kent Core Requirement	3
	General Elective	3
Credit Hours		15
Semester Eight		Credits
!	PHY 40020 ADVANCED PHYSICS LABORATORY (WIC)	2
!	PHY 45501 ELECTROMAGNETIC WAVES AND MODERN OPTICS	3
	Physics (PHY) Upper-Division Elective (PHY 30000 or 40000)	3
	General Electives	5
Credit Hours		13
Minimum Total Credit Hours:		120

### Biological Sciences Concentration

This roadmap is a recommended semester-by-semester plan of study for this major. However, courses designated as critical (!) must be completed in the semester listed to ensure a timely graduation.

Semester One		Credits
!	CHEM 10060 GENERAL CHEMISTRY I (KBS)	4
!	CHEM 10062 GENERAL CHEMISTRY I LABORATORY (KBS) (KLAB)	1
!	MATH 12002 ANALYTIC GEOMETRY AND CALCULUS I (KMCR)	5
!	PHY 12000 INTRODUCTORY PHYSICS SEMINAR (ELR)	1
	UC 10097 DESTINATION KENT STATE: FIRST YEAR EXPERIENCE	1
	Kent Core Requirement	3
Credit Hours		15
Semester Two		Credits
!	CHEM 10061 GENERAL CHEMISTRY II (KBS)	4
!	CHEM 10063 GENERAL CHEMISTRY II LABORATORY (KBS) (KLAB)	1
!	MATH 12003 ANALYTIC GEOMETRY AND CALCULUS II	5
!	PHY 23101 GENERAL UNIVERSITY PHYSICS I (KBS) (KLAB)	5
Credit Hours		15
Semester Three		Credits
!	BSCI 10110 BIOLOGICAL DIVERSITY (KBS) (KLAB)	4
!	MATH 32051 MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES I	4
!	PHY 23102 GENERAL UNIVERSITY PHYSICS II (KBS) (KLAB)	5
	Kent Core Requirement	3
Credit Hours		16
Semester Four		Credits
!	BSCI 10120 BIOLOGICAL FOUNDATIONS (KBS) (KLAB)	4

!	MATH 32052	MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES II	4	
!	PHY 36001	INTRODUCTORY MODERN PHYSICS	3	
Kent Core Requirement			3	
Credit Hours			14	
<b>Semester Five</b>				
!	BSCI 30156	ELEMENTS OF GENETICS	3	
!	PHY 35101	CLASSICAL MECHANICS	4	
Foreign Language			4	
Major Elective			3	
Credit Hours			14	
<b>Semester Six</b>				
!	BSCI 30140	CELL BIOLOGY	4	
!	PHY 30020	INTERMEDIATE PHYSICS LABORATORY (WIC)	2	
Foreign Language			4	
Kent Core Requirement			3	
Kent Core Requirement			3	
Credit Hours			16	
<b>Semester Seven</b>				
!	BSCI 40163	EVOLUTION	3	
!	PHY 40092	INTERNSHIP IN PHYSICS (ELR)	2	
!	PHY 45201	ELECTROMAGNETIC THEORY	4	
Kent Core Requirement			3	
Kent Core Requirement			3	
Credit Hours			15	
<b>Semester Eight</b>				
!	PHY 40020	ADVANCED PHYSICS LABORATORY (WIC)	2	
!	PHY 45301	THERMAL PHYSICS	3	
PHY 46101			QUANTUM MECHANICS	4
General Electives			6	
Credit Hours			15	
Minimum Total Credit Hours:			120	

## Chemistry Concentration

This roadmap is a recommended semester-by-semester plan of study for this major. However, courses designated as critical (!) must be completed in the semester listed to ensure a timely graduation.

	<b>Semester One</b>	<b>Credits</b>		
!	CHEM 10060	GENERAL CHEMISTRY I (KBS)	4	
!	CHEM 10062	GENERAL CHEMISTRY I LABORATORY (KBS) (KLAB)	1	
!	MATH 12002	ANALYTIC GEOMETRY AND CALCULUS I (KMCR)	5	
!	PHY 12000	INTRODUCTORY PHYSICS SEMINAR (ELR)	1	
UC 10097			DESTINATION KENT STATE: FIRST YEAR EXPERIENCE	1
Kent Core Requirement			3	
Credit Hours			15	
<b>Semester Two</b>				
!	CHEM 10061	GENERAL CHEMISTRY II (KBS)	4	
!	CHEM 10063	GENERAL CHEMISTRY II LABORATORY (KBS) (KLAB)	1	
!	MATH 12003	ANALYTIC GEOMETRY AND CALCULUS II	5	
!	PHY 23101	GENERAL UNIVERSITY PHYSICS I (KBS) (KLAB)	5	
Credit Hours			15	
<b>Semester Three</b>				
CHEM 30481			ORGANIC CHEMISTRY I	3

!	MATH 32051	MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES I	4	
!	PHY 23102	GENERAL UNIVERSITY PHYSICS II (KBS) (KLAB)	5	
Kent Core Requirement			3	
Credit Hours			15	
<b>Semester Four</b>				
CHEM 30482			ORGANIC CHEMISTRY II	3
!	MATH 32052	MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES II	4	
!	PHY 36001	INTRODUCTORY MODERN PHYSICS	3	
Kent Core Requirement			3	
General Elective			3	
Credit Hours			16	
<b>Semester Five</b>				
!	PHY 35101	CLASSICAL MECHANICS	4	
!	PHY 36002	APPLICATIONS OF MODERN PHYSICS	3	
Foreign Language			4	
Kent Core Requirements			3	
Credit Hours			14	
<b>Semester Six</b>				
!	CHEM 30301	INORGANIC CHEMISTRY I	2	
!	PHY 30020	INTERMEDIATE PHYSICS LABORATORY (WIC)	2	
!	PHY 45301	THERMAL PHYSICS	3	
PHY 46101			QUANTUM MECHANICS	4
Foreign Language			4	
Credit Hours			15	
<b>Semester Seven</b>				
!	CHEM 30105	ANALYTICAL CHEMISTRY I	3	
!	CHEM 30107	ANALYTICAL CHEMISTRY LABORATORY I (WIC)	1	
!	PHY 40092	INTERNSHIP IN PHYSICS (ELR)	2	
!	PHY 45201	ELECTROMAGNETIC THEORY	4	
Kent Core Requirement			3	
Kent Core Requirement			3	
Credit Hours			16	
<b>Semester Eight</b>				
!	PHY 40020	ADVANCED PHYSICS LABORATORY (WIC)	2	
Physics (PHY) Electives			6	
Kent Core Requirement			3	
General Electives			3	
Credit Hours			14	
Minimum Total Credit Hours:			120	

## Computer Science concentration

This roadmap is a recommended semester-by-semester plan of study for this major. However, courses designated as critical (!) must be completed in the semester listed to ensure a timely graduation.

	<b>Semester One</b>	<b>Credits</b>		
!	MATH 12002	ANALYTIC GEOMETRY AND CALCULUS I (KMCR)	5	
!	PHY 12000	INTRODUCTORY PHYSICS SEMINAR (ELR)	1	
UC 10097			DESTINATION KENT STATE: FIRST YEAR EXPERIENCE	1
Kent Core Requirement			3	
Kent Core Requirement			3	
General Elective			3	
Credit Hours			16	

**Semester Two**

!	CS 13011 & CS 13012 or CS 13001	COMPUTER SCIENCE IA: PROCEDURAL PROGRAMMING and COMPUTER SCIENCE IB: OBJECT ORIENTED PROGRAMMING or COMPUTER SCIENCE I: PROGRAMMING AND PROBLEM SOLVING	4
!	MATH 12003	ANALYTIC GEOMETRY AND CALCULUS II	5
!	PHY 23101	GENERAL UNIVERSITY PHYSICS I (KBS) (KLAB)	5
Credit Hours			14

**Semester Three**

!	CS 23022	DISCRETE STRUCTURES FOR COMPUTER SCIENCE	3
!	MATH 32051	MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES I	4
!	PHY 23102	GENERAL UNIVERSITY PHYSICS II (KBS) (KLAB)	5
Foreign Language			4
Credit Hours			16

**Semester Four**

!	MATH 32052	MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES II	4
!	PHY 36001	INTRODUCTORY MODERN PHYSICS	3
Foreign Language			4
Kent Core Requirement			3
Credit Hours			14

**Semester Five**

!	PHY 30020	INTERMEDIATE PHYSICS LABORATORY (WIC)	2
!	PHY 35101	CLASSICAL MECHANICS	4
!	PHY 36002	APPLICATIONS OF MODERN PHYSICS	3
!	PHY 45201	ELECTROMAGNETIC THEORY	4
Kent Core Requirement			3
Credit Hours			16

**Semester Six**

!	CS 23001	COMPUTER SCIENCE II: DATA STRUCTURES AND ABSTRACTION	4
	PHY 46101	QUANTUM MECHANICS	4
	Physics (PHY) Upper-Division Elective (30000 or 40000 level)		3
Kent Core Requirement			3
Credit Hours			14

**Semester Seven**

!	CHEM 10060	GENERAL CHEMISTRY I (KBS)	4
!	CHEM 10062	GENERAL CHEMISTRY I LABORATORY (KBS) (KLAB)	1
!	CS 42201	INTRODUCTION TO NUMERICAL COMPUTING I	3
!	PHY 40020	ADVANCED PHYSICS LABORATORY (WIC)	2
!	PHY 40092	INTERNSHIP IN PHYSICS (ELR)	2
Kent Core Requirement			3
Credit Hours			15

**Semester Eight**

!	CHEM 10061	GENERAL CHEMISTRY II (KBS)	4
!	CHEM 10063	GENERAL CHEMISTRY II LABORATORY (KBS) (KLAB)	1
	Physics (PHY) Upper-Division Elective (30000 or 40000 level)		3
Kent Core Requirements			3
General Elective			4
Credit Hours			15
Minimum Total Credit Hours:			120

**Entrepreneurship concentration**

This roadmap is a recommended semester-by-semester plan of study for this major. However, courses designated as critical (!) must be completed in the semester listed to ensure a timely graduation.

**Semester One**

!	CHEM 10060	GENERAL CHEMISTRY I (KBS)	4
!	CHEM 10062	GENERAL CHEMISTRY I LABORATORY (KBS) (KLAB)	1
!	MATH 12002	ANALYTIC GEOMETRY AND CALCULUS I (KMCR)	5
!	PHY 12000	INTRODUCTORY PHYSICS SEMINAR (ELR)	1
	UC 10097	DESTINATION KENT STATE: FIRST YEAR EXPERIENCE	1
Kent Core Requirement			3
Credit Hours			15

**Semester Two**

!	CHEM 10061	GENERAL CHEMISTRY II (KBS)	4
!	CHEM 10063	GENERAL CHEMISTRY II LABORATORY (KBS) (KLAB)	1
!	MATH 12003	ANALYTIC GEOMETRY AND CALCULUS II	5
!	PHY 23101	GENERAL UNIVERSITY PHYSICS I (KBS) (KLAB)	5
Credit Hours			15

**Semester Three**

!	ECON 22060	PRINCIPLES OF MICROECONOMICS (KSS)	3
!	ENTR 27056	INTRODUCTION TO ENTREPRENEURSHIP	3
!	MATH 32051	MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES I	4
!	PHY 23102	GENERAL UNIVERSITY PHYSICS II (KBS) (KLAB)	5
Credit Hours			15

**Semester Four**

!	MATH 32052	MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES II	4
!	PHY 36001	INTRODUCTORY MODERN PHYSICS	3
Kent Core Requirement			3
Kent Core Requirement			3
General Elective			3
Credit Hours			16

**Semester Five**

	ACCT 23020 or ENTR 37040	INTRODUCTION TO FINANCIAL ACCOUNTING or ENTREPRENEURIAL TOOLS	3
!	PHY 35101	CLASSICAL MECHANICS	4
	PHY 45201	ELECTROMAGNETIC THEORY	4
Foreign Language			4
Credit Hours			15

**Semester Six**

	ENTR 27466	SPEAKER SERIES IN ENTREPRENEURSHIP	1
	ENTR 37065	ENTREPRENEURIAL FINANCE	3
	MKTG 25010	PRINCIPLES OF MARKETING	3
!	PHY 30020	INTERMEDIATE PHYSICS LABORATORY (WIC)	2
Foreign Language			4
Kent Core Requirement			3
Credit Hours			16

**Semester Seven**

!	PHY 40092	INTERNSHIP IN PHYSICS (ELR)	2
	Physics (PHY) Upper-Division Elective (PHY 30000 or 40000)		3
Kent Core Requirement			3
Kent Core Requirement			3

General Elective	3
Credit Hours	14
<b>Semester Eight</b>	
! PHY 40020 ADVANCED PHYSICS LABORATORY (WIC)	2
Physics (PHY) Upper-Division Elective (PHY 30000 or 40000)	6
Kent Core Requirement	3
General Electives	3
Credit Hours	14
Minimum Total Credit Hours:	120

## Mathematical Physics Concentration

This roadmap is a recommended semester-by-semester plan of study for this major. However, courses designated as critical (!) must be completed in the semester listed to ensure a timely graduation.

Semester One	Credits
! CHEM 10060 GENERAL CHEMISTRY I (KBS)	4
! CHEM 10062 GENERAL CHEMISTRY I LABORATORY (KBS) (KLAB)	1
! MATH 12002 ANALYTIC GEOMETRY AND CALCULUS I (KMCR)	5
! PHY 12000 INTRODUCTORY PHYSICS SEMINAR (ELR)	1
UC 10097 DESTINATION KENT STATE: FIRST YEAR EXPERIENCE	1
Kent Core Requirement	3
Credit Hours	15
<b>Semester Two</b>	
! CHEM 10061 GENERAL CHEMISTRY II (KBS)	4
! CHEM 10063 GENERAL CHEMISTRY II LABORATORY (KBS) (KLAB)	1
! MATH 12003 ANALYTIC GEOMETRY AND CALCULUS II	5
! PHY 23101 GENERAL UNIVERSITY PHYSICS I (KBS) (KLAB)	5
Credit Hours	15
<b>Semester Three</b>	
! CS 13011 COMPUTER SCIENCE IA: PROCEDURAL PROGRAMMING & CS 13012 and COMPUTER SCIENCE IB: OBJECT ORIENTED PROGRAMMING or CS 13001 or COMPUTER SCIENCE I: PROGRAMMING AND PROBLEM SOLVING	4
! MATH 32051 MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES I	4
! PHY 23102 GENERAL UNIVERSITY PHYSICS II (KBS) (KLAB)	5
General Elective	3
Credit Hours	16
<b>Semester Four</b>	
! MATH 32052 MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES II	4
! PHY 36001 INTRODUCTORY MODERN PHYSICS	3
Kent Core Requirement	3
Kent Core Requirement	3
General Elective	3
Credit Hours	16
<b>Semester Five</b>	
! PHY 35101 CLASSICAL MECHANICS	4
! PHY 36002 APPLICATIONS OF MODERN PHYSICS	3
! PHY 45201 ELECTROMAGNETIC THEORY	4
Foreign Language	4
Credit Hours	15

Semester Six	Credits
! PHY 30020 INTERMEDIATE PHYSICS LABORATORY (WIC)	2
! PHY 45403 DATA ANALYSIS AND COMPUTATIONAL PHYSICS TECHNIQUES	3
PHY 46101 QUANTUM MECHANICS	4
Foreign Language	4
Credit Hours	13
<b>Semester Seven</b>	
! PHY 40092 INTERNSHIP IN PHYSICS (ELR)	2
! PHY 45401 MATHEMATICAL METHODS IN PHYSICS	4
Physics (PHY) Elective	3
Kent Core Requirement	3
Kent Core Requirement	3
Credit Hours	15
<b>Semester Eight</b>	
! PHY 40020 ADVANCED PHYSICS LABORATORY (WIC)	2
Physics (PHY) Elective	6
Kent Core Requirement	3
Kent Core Requirement	3
General Elective	1
Credit Hours	15
Minimum Total Credit Hours:	120

## Pre-Medicine/Pre-Osteopathy Concentration

This roadmap is a recommended semester-by-semester plan of study for this major. However, courses designated as critical (!) must be completed in the semester listed to ensure a timely graduation.

Semester One	Credits
! CHEM 10060 GENERAL CHEMISTRY I (KBS)	4
! CHEM 10062 GENERAL CHEMISTRY I LABORATORY (KBS) (KLAB)	1
! MATH 12002 ANALYTIC GEOMETRY AND CALCULUS I (KMCR)	5
! PHY 12000 INTRODUCTORY PHYSICS SEMINAR (ELR)	1
! PHY 23101 GENERAL UNIVERSITY PHYSICS I (KBS) (KLAB)	5
UC 10097 DESTINATION KENT STATE: FIRST YEAR EXPERIENCE	1
Credit Hours	17
<b>Semester Two</b>	
! CHEM 10061 GENERAL CHEMISTRY II (KBS)	4
! CHEM 10063 GENERAL CHEMISTRY II LABORATORY (KBS) (KLAB)	1
! MATH 12003 ANALYTIC GEOMETRY AND CALCULUS II	5
! PHY 23102 GENERAL UNIVERSITY PHYSICS II (KBS) (KLAB)	5
Credit Hours	15
<b>Semester Three</b>	
! BSCI 10120 BIOLOGICAL FOUNDATIONS (KBS) (KLAB)	4
! CHEM 30475 ORGANIC CHEMISTRY LABORATORY I (ELR)	1
! CHEM 30481 ORGANIC CHEMISTRY I	3
! MATH 32051 MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES I	4
PSYC 11762 GENERAL PSYCHOLOGY (DIVD) (KSS)	3
Credit Hours	15
<b>Semester Four</b>	
! BSCI 30140 CELL BIOLOGY	4
! CHEM 30476 ORGANIC CHEMISTRY LABORATORY II	1
! CHEM 30482 ORGANIC CHEMISTRY II	3



!	MATH 32052	MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES II	4
!	PHY 36001	INTRODUCTORY MODERN PHYSICS	3
Credit Hours			15
<b>Semester Five</b>			
!	BSCI 30130 or BSCI 40430	HUMAN PHYSIOLOGY or ANIMAL PHYSIOLOGY	3
!	BSCI 30156	ELEMENTS OF GENETICS	3
!	PHY 35101	CLASSICAL MECHANICS	4
	SOC 12050	INTRODUCTION TO SOCIOLOGY (DIVD) (KSS)	3
Concentration Elective or Kent Core Requirement			3
Credit Hours			16
<b>Semester Six</b>			
!	BSCI 30171	GENERAL MICROBIOLOGY	4
!	CHEM 30284 or CHEM 40245	INTRODUCTORY BIOLOGICAL CHEMISTRY or BIOCHEMICAL FOUNDATIONS OF MEDICINE	4
!	PHY 30020	INTERMEDIATE PHYSICS LABORATORY (WIC)	2
Concentration Elective or Kent Core Requirement			3
Kent Core Requirement			3
Credit Hours			16
<b>Semester Seven</b>			
!	PHY 40092	INTERNSHIP IN PHYSICS (ELR)	2
!	PHY 45201	ELECTROMAGNETIC THEORY	4
Foreign Language			4
Kent Core Requirement			3
Credit Hours			13
<b>Semester Eight</b>			
!	PHY 40020	ADVANCED PHYSICS LABORATORY (WIC)	2
Foreign Language			4
Kent Core Requirement			3
Kent Core Requirement			3
General Elective			1
Credit Hours			13
Minimum Total Credit Hours:			120

### Research Concentration

This roadmap is a recommended semester-by-semester plan of study for this major. However, courses designated as critical (!) must be completed in the semester listed to ensure a timely graduation.

			Credits
<b>Semester One</b>			
!	MATH 12002	ANALYTIC GEOMETRY AND CALCULUS I (KMCR)	5
!	PHY 12000	INTRODUCTORY PHYSICS SEMINAR (ELR)	1
!	PHY 23101	GENERAL UNIVERSITY PHYSICS I (KBS) (KLAB)	5
	UC 10097	DESTINATION KENT STATE: FIRST YEAR EXPERIENCE	1
Kent Core Requirement			3
Credit Hours			15
<b>Semester Two</b>			
!	MATH 12003	ANALYTIC GEOMETRY AND CALCULUS II	5
!	PHY 23102	GENERAL UNIVERSITY PHYSICS II (KBS) (KLAB)	5
Kent Core Requirement			3
Kent Core Requirement			3
Credit Hours			16
<b>Semester Three</b>			
!	CHEM 10060	GENERAL CHEMISTRY I (KBS)	4

!	CHEM 10062	GENERAL CHEMISTRY I LABORATORY (KBS) (KLAB)	1
!	MATH 32051	MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES I	4
Foreign Language			4
Kent Core Requirement			3
Credit Hours			16
<b>Semester Four</b>			
!	CHEM 10061	GENERAL CHEMISTRY II (KBS)	4
!	CHEM 10063	GENERAL CHEMISTRY II LABORATORY (KBS) (KLAB)	1
!	MATH 32052	MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES II	4
!	PHY 36001	INTRODUCTORY MODERN PHYSICS	3
Foreign Language			4
Credit Hours			16
<b>Semester Five</b>			
!	CS 13011 & CS 13012 or CS 13001	COMPUTER SCIENCE IA: PROCEDURAL PROGRAMMING and COMPUTER SCIENCE IB: OBJECT ORIENTED PROGRAMMING or COMPUTER SCIENCE I: PROGRAMMING AND PROBLEM SOLVING	4
!	PHY 35101	CLASSICAL MECHANICS	4
!	PHY 36002	APPLICATIONS OF MODERN PHYSICS	3
!	PHY 45201	ELECTROMAGNETIC THEORY	4
Credit Hours			15
<b>Semester Six</b>			
!	PHY 30020	INTERMEDIATE PHYSICS LABORATORY (WIC)	2
!	PHY 45301	THERMAL PHYSICS	3
!	PHY 45403	DATA ANALYSIS AND COMPUTATIONAL PHYSICS TECHNIQUES	3
!	PHY 46101	QUANTUM MECHANICS	4
Physics (PHY) Elective			3
Credit Hours			15
<b>Semester Seven</b>			
!	PHY 40092	INTERNSHIP IN PHYSICS (ELR)	2
Physics (PHY) Elective			2
Kent Core Requirement			3
Kent Core Requirement			3
General Elective			3
Credit Hours			13
<b>Semester Eight</b>			
!	PHY 40020	ADVANCED PHYSICS LABORATORY (WIC)	2
Physics (PHY) Elective (PHY 30000 or 40000 level)			4
Kent Core Requirement			3
General Electives			5
Credit Hours			14
Minimum Total Credit Hours:			120