



PHYSICS MAJOR

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The Department of Mathematics and Physics offers a major and a minor program of study in physics. Physicists seek a description of nature in terms of its most fundamental entities. They study systems ranging in size and complexity from quarks to the universe itself. The offerings of the department are planned to meet the following needs: (1) general cultural knowledge, (2) specific group requirements for majors in other departments, (3) basic subject matter for those preparing to enter various branches of engineering or other technical schools, and (4) a major in physics, for those intending to enter industry or to continue in graduate school.

Because of the emphasis placed on mathematics, chemistry, and computer science in the physics program, some students select an additional major or minor in one of these subjects.

Physical Chemistry I and II (CHM 424, 425, 434, and 435 may be substituted for PHY 314 Thermodynamics and PHY 315 Modern Physics. Majors must earn a grade of C- or better in all physics courses needed to satisfy major requirements.

You can find the course descriptions for all courses required for this major by clicking on the following links:

- [Chemistry Course Descriptions](#)
- [Mathematics Course Descriptions](#)
- [Physics Course Descriptions](#)

Major: **PHYSICS**

Student's Last Name

First Name

Middle Initial

Advisor

Date Major Declared

Course #	Title of Course	Hours Required	Semester Completed	Grade
Required Courses				
PHY 201	Physics I	4		
PHY 212	Physics II	4		
PHY 223	Physics III	3		
PHY 314	Thermodynamics	4		
PHY 315	Modern Physics	4		
PHY 324	Light	4		
or PHY 325	Electronics	4		
PHY 415 - 416	Introduction to Theoretical Physics I & II	8		
	Total Hours for Required Courses	31 hrs.		
Other Requirements:				
Mathematics through MAT 312 Differential Equations		21-24 hrs.		
	MAT 090 or equivalent	2		
	MAT 111 or equivalent	3		
	MAT 121 or equivalent	3		
	MAT 124 or equivalent	5		
	MAT 214 or equivalent	4		
	MAT 224 or equivalent	3		
MAT 312	Differential Equations	3		
CHM 114, 115	General Chemistry I (lecture and lab)	4		
CHM 124, 125	General Chemistry II (lecture and lab)	4		
Choose one of the following three options (6-8 hrs):				
•	Completion of a two-semester sequence of courses in French or German, or certification of reading knowledge in one of the languages by the Department of Foreign Languages.	8		
•	CSC 104 and (MAT 325 Introduction to Numerical Analysis OR MAT 215 Linear Algebra)	6		
•	Six hours of computer science including CSC 111 Fundamentals of Computer Science I	6		
	TOTAL HOURS FOR MAJOR	66-71 hrs.		

If any substitutions or waivers of requirements are allowed, please list below and initial.

CHM – Chemistry

CHM 105 Introduction to Chemistry (3 hrs.) A survey course intended for non-science majors. Chemical phenomena, methodology, and theory are presented in the context of public policy issues such as air and water quality, the ozone layer, global warming, acid rain, and energy sources.

CHM 106 Introduction to Chemistry Laboratory (1 hr.) Laboratory experiences are provided that are relevant to the science and technology issues discussed in CHM 105. Meets three hours per week. Experimentation and data collection lead to an understanding of the scientific method and of the role that chemistry plays in addressing societal issues.

CHM 114 General Chemistry I (3 hrs.) A study of the fundamental principles and theories of chemistry with emphasis on stoichiometry, atomic theory, and bonding. This course is offered in every fall semester.

CHM 115 General Chemistry I Laboratory (1 hr.) Laboratory to accompany CHM 114. Meets three hours per week.

CHM 124 General Chemistry II (3 hrs.) A continuation of CHM 114 with emphasis on equilibrium, electrochemistry, kinetics, and thermodynamics. This course is offered every spring semester.

CHM 125 General Chemistry II Laboratory (1 hr.) Laboratory to accompany CHM 124. Meets three hours per week.

CHM 304 Inorganic Chemistry (3 hrs.) A survey of inorganic chemistry at the intermediate level. Emphasis is on descriptive chemistry with discussion also of atomic and molecular structure, bonding theory, coordination chemistry, and energy changes in inorganic reactions. Prerequisites: CHM 124/125.

CHM 314 Organic Chemistry I (3 hrs.) A systematic study of the compounds of carbon with emphasis on the principles of synthesis, analysis, and reaction mechanisms of organic functional groups. This course is offered every fall semester. Prerequisites: CHM 124/125.

CHM 315 Organic Chemistry I Laboratory (1 hr.) Laboratory to accompany CHM 314. A study of the techniques of synthesis and analysis of organic compounds. Meets three hours per week. Prerequisites: CHM 124/125.

CHM 324 Organic Chemistry II (3 hrs.) A continuation of CHM 314. This course is offered every spring semester.

CHM 325 Organic Chemistry II Laboratory (1 hr.) Laboratory to accompany CHM 324. Meets three hours per week.

CHM 334 Analytical Chemistry I (3 hrs.) A study of the principles and methods of quantitative analysis. Prerequisites: CHM 124/125.

CHM 335 Analytical Chemistry I Laboratory (1 hr.) Laboratory to accompany CHM 334. Gravimetric, volumetric and simple instrumental methods are studied. Meets three hours per week. Prerequisites: CHM 124/125.

CHM 344 Analytical Chemistry II (2 hrs.) Introduction to instrumental methods of analysis with emphasis on the principles of measurement and instrumentation. Prerequisites: CHM 334/335.

CHM 345 Analytical Chemistry II Laboratory (2 hrs.) Laboratory to accompany CHM 344. Methods may include polarography, spectrophotometry, chromatography, potentiometric titrations, and amperometric and conductometric determinations. Meets six hours per week.

CHM 404 Biophysical Chemistry (3 hrs.) Introduction to physical chemistry with special emphasis on biological applications. Topics to be discussed include thermodynamics, chemical and physical equilibria, and kinetics (especially enzyme kinetics). Designed for those students who would otherwise not be exposed to physical chemistry. Prerequisites: CHM 124/125, MAT 124.

CHM 410 Advanced Topics in Chemistry (3 hrs.) Special courses on various topics are offered under this listing. Past offerings include Medicinal Chemistry and Chemical Kinetics. May be repeated for credit with change of topic.

CHM 422 Advanced Inorganic Chemistry (3 hrs.) A study of the principles and theories of inorganic chemistry, emphasizing modern approaches to the field. Prerequisites: CHM 304, 324/325, MAT 224, and PHY 212, or permission of the instructor.

CHM 424 Physical Chemistry I (3 hrs.) Chemical thermodynamics and kinetics. Topics include properties of gases, laws of thermodynamics, free energy, chemical equilibrium, chemical kinetics, and rate laws. Additional topics may include chemical dynamic models, phase equilibrium, and electrochemistry. Prerequisites: CHM 124/125, MAT 214, and PHY 212 or PHY 213 or with permission of instructor.

CHM 425 Physical Chemistry I Laboratory (1 hr.) Laboratory to accompany CHM 424. Meets three hours per week. Prerequisites: CHM 324/325, CHM 344/345, MAT 224, PHY 212.

CHM 434 Physical Chemistry II (3 hrs.) Quantum and statistical mechanics. Topics include quantum mechanical theory, quantum mechanical models for motion, the structure of atoms and molecules, molecular spectroscopy, and statistical thermodynamics. Prerequisites: CHM 424.

CHM 435 Physical Chemistry II Laboratory (1 hr.) Laboratory to accompany CHM 434. Meets three hours per week.

MAT – Mathematics

MAT 110 Quantitative Reasoning for Mathematical Problem Solving (3 hrs.) This course emphasizes basic mathematical principles through problem solving. The focus is on solving problems encountered in typical college courses such as interpreting graphs, applying formulas, computing interest and percentages, understanding statistical output, and solving equations. The quantitative reasoning approach builds critical thinking skills in solving problems and analyzing the outcomes of those contextually. This course is designed for those students who will broadly use mathematics in everyday life, with less technical emphasis on skills for future math courses. This course is for those who do not intend to major in programs requiring additional mathematics. Offered every semester. Prerequisites: None

MAT 111 College Algebra (3 hrs.) The study of linear, quadratic, exponential and logarithmic equations, inequalities, functions and graphs and their applications. Prerequisites: ACT math score between 19 and 23 or SAT math score between 410 and 530 or Accuplacer Advanced Algebra and Functions score of 241 and at least 2 years of high school algebra with at least C's. Not meeting prerequisite requires the student to successfully complete MAT 110 as the Foundational Mathematics requirement. Offered every semester, one or more sections depending on demand.

MAT 114 Elementary Statistics (3 hrs.) A study of the organization and analysis of data including the normal, binomial, chi square and t distributions; estimating population parameters; hypothesis testing; random sampling; central limit theorem; and simple linear regression and correlation. A term project using technology for analysis and testing of data collected from real life is a required component of the course. Prerequisites: ACT math score 23 or SAT math score 540 and 4 years of high school math, including 2 years of algebra with at least B's. Not having prerequisite requires the student to successfully complete MAT 110 Quantitative Reasoning for Mathematical Problem Solving or MAT 111 College Algebra with a grade of C- or better. Offered every semester.

MAT 115 Fundamentals of Data Science (3 hrs.) The focus of this course is to introduce the scientific methods and processes used to analyze large data sets and predictive modeling methods. The course will use statistical methods and exploration techniques to investigate patterns and anomalies in mostly structured large data sets. Underlying theories of statistics will be utilized to explore, interpret, and visualize data in interdisciplinary fields such as health, business, education, and economics. An introduction to R programming language and R Studio will be used throughout the course. Pre-requisites: Evidence of college level statistics course with a grade of C- or better, a math ACT of 25 or higher, a math SAT score of 610 or higher, or AP stats with a score of "4" or higher. Offered spring semester.

MAT 121 Pre-Calculus (3 hrs.) The study of trigonometric, exponential, logarithmic and algebraic functions and their applications. Pre-Calculus is a course for students who plan to take Calculus I. Prerequisites: ACT math score 22 or SAT math score 540 and at least 4 years of high school math, including 2 years of algebra with at least B's. Not meeting prerequisite requires the student successfully complete MAT 111 with a grade of C- or better. Offered every semester or depending upon demand.

MAT 122 Business Calculus (3 hrs.) A terminal calculus course, including a brief review of algebra and the study of the derivatives and integrals of algebraic, exponential and logarithmic functions. Business applications of the derivative and the definite integral are also studied. Prerequisites: ACT math score 23 or SAT math score 540 and at least 4 years of high school math, including 2 years of algebra and some pre-calculus with at least B's. Students not meeting these prerequisites requires the students to successfully complete MAT 111 with a grade of C- or better. Offered every semester or depending upon demand.

MAT 124 Calculus I (5 hrs.) A formal introduction to calculus, including limits, derivatives, techniques of differentiation, optimization, anti-derivatives, definite integrals, and the fundamental theorem of calculus. Applications in science and engineering are included. Prerequisites: ACT math score of 25 (27 preferred) or SAT math score of 600 (630 preferred) and at least 4 years of high school math, including a pre-calculus or trigonometry course with a grade of at least B. Not having prerequisite requires the student to successfully complete MAT 121, Pre-calculus with a grade of C- or better. Offered every semester.

NOTE: A course **leading to the fulfillment** of the Breakthrough math requirement (MAT 114 or MAT 124) must be taken in the first year (MAT 090 Intermediate Algebra, MAT 111 College Algebra, MAT 114 Elementary Statistics, MAT 121 Pre-Calculus, or MAT 124 Calculus I).

MAT 214 Calculus II (4 hrs.) A continuation of MAT 124. This course includes integration of standard forms (integration by parts, trigonometric substitution, etc.), the definite integral, applications of integration and the study of sequences and series. Prerequisites: Completion of MAT 124 with a C- or better, or permission of the instructor. Offered every semester or depending upon demand.

MAT 215 Linear Algebra (3 hrs.) An introduction to the concepts of linear transformations and matrices, determinants, vector spaces, eigenvalues, and selected applications. Prerequisites: Completion of MAT 124 with a C- or better. Offered every fall semester.

MAT 224 Calculus III (4 hrs.) A continuation of MAT 214. This course includes solid analytic geometry, an introduction to vector analysis and differential geometry, partial differentiation and multiple integration. Prerequisites: Completion of MAT 214 with a C- or better. Offered every semester or depending upon demand.

MAT 231 Mathematics for Elementary & Middle School Teachers (3 hrs.) This is the first part of a two-part integrated methods and content course for elementary teachers. This part focuses on the "why" along with the "how" of such topics as problem solving, deductive and inductive reasoning, beginning number concepts, operations with whole numbers, elementary number theory and other appropriate topics such as learning theory and assessment. Prerequisites: Completion of the Tier I mathematics or Foundational math requirement in Breakthrough requirement with a C- or better. Offered every fall semester.

MAT 305 Heart of Mathematics (3 hrs.) A semester-long discussion of the big ideas of mathematics in cultural and applications contexts. Evolution of mathematical ideas in art, the sciences, computing, literature and other disciplines. An introduction to mathematical thinking and problem-solving in many contexts. Prerequisites: MAT 214 with a C- or better, or permission of instructor. Offered in the spring semester of even years.

MAT 310 History of Mathematics (3 hrs.) This course is taught from the viewpoint that mathematics has been a major cultural force in many civilizations. The course will trace the evolution of mathematics and its impact on the human endeavor as civilizations rose and fell throughout history to modern times. Prerequisites: Completion of MAT 124 with a C- or better. Offered in the fall semester of odd years.

MAT 312 Differential Equations (3 hrs.) A study of ordinary differential equations (ODEs). This course is focused on the analytical, geometrical, and numerical aspects of differential equations. First and second order ODEs are studied using various analytical techniques. The Laplace transform is utilized to solve initial value problems of higher-order ODEs. Particular attention is paid to systems of ODEs using phase portraits and numerical analyses. Offered spring semester of odd years. Prerequisites: Completion of CSC 104 and MAT 224 with a C- or better, or by permission of instructor.

MAT 313 Mathematical Probability and Statistics (3 hrs.) This course introduces the student to the mathematics of probability and statistics. The concepts of discrete and continuous probability distributions are studied in detail. The material is applied to the areas of statistical inference, including estimation and hypothesis testing. Offered every spring semester. Prerequisites: Completion of MAT 214 with a C- or better or concurrent enrollment in MAT 214.

MAT 314 Higher Geometry (3 hrs.) A study of various geometric axiomatic systems from both the synthetic and analytic approach, including finite and non-Euclidean geometries. Offered every fall semester or depending upon demand. Prerequisites: Completion of MAT 331 with a C- or better.

MAT 321 Discrete Mathematics and Graph Theory (3 hrs.) This course provides an introduction to an area of mathematics focusing on discrete rather than continuous mathematical structures. Topics explored in this course include number theory, functions and sequences, graph theory, combinatorics, and set theory. Basic definitions and concepts of the field as well as some major results in the area will be discussed. This course prepares students for further study in mathematics, business, or computer-related fields. Pre-requisite: MAT 214 with a grade of C- or better. Offered in even fall semesters.

MAT 331 Mathematics Seminar (3 hrs.) A study of the foundations of mathematics, logical deductive reasoning and proof. Emphasis is on sets and number theory. This course prepares the mathematics major for success in other 300- and 400-level mathematics courses. Prerequisites: Completion of CSC 104 with a C- or better; and MAT 224 with a C- or better or permission of the instructor. Offered every spring semester.

MAT 340 Statistical Computer in R Studio (3 hrs.) A projects-based introduction to R and R Studio with applications in relevant fields. The focus of this course is to work with pre-processed data and flat files, access and format large data from the web, analyze data by methods such as conditional means, regression analysis, and cross-validation techniques, with the focus on statistically analyzing and presenting the data.

MAT 351 Methods of Teaching Elementary & Middle School Mathematics (3 hrs.) This course is the second part of an integrated methods and content course for elementary teachers. Topics include fractions, decimals, geometry, probability and statistics, measurement and other appropriate topics. Offered every spring semester. Prerequisites: C- or better in MAT 231 or permission of the instructor.

MAT 398 Independent Study (1-4 hrs.) Individual study and/or research under the supervision of staff members on a particular topic agreed upon by both the student and the instructor. Enrollment by permission of the instructor and department chair.

MAT 411 Data Science Seminar (3 hrs.) This is a capstone course for majors. Each individual in the class carries out research under the supervision of the instructor in large-scale data analysis using statistical knowledge and computational techniques learned in previous courses. Literature review, regular meetings, progress reports, and a final paper and presentation are required. Topics may be chosen from interdisciplinary fields including, but not limited to, computer science, biology, psychology, engineering, and business. Offered every other spring semester. Prerequisites: MAT 340, ECN 355, and CSC 211 with a grade of C- or better.

MAT 422 Modern Algebra (3 hrs.) A study of the axiomatic development of algebraic structures, including groups, rings, and fields, with selected introductions to topics which may include symmetry groups, factorization, and integral domains. Offered every spring semester. Prerequisites: Completion of CSC 104 and MAT 331 with a C- or better.

MAT 424 Advanced Calculus (3 hrs.) This course is a rigorous study of the foundations of Calculus with emphasis on limits, continuity, differentiation, and Riemann integration. Through the reexamination of those topics, students learn proof techniques which are fundamental to the mathematical field of analysis. Prerequisites: Completion of CSC 104, MAT 331, and MAT 224 with grades of C- or better. Offered every fall semester.

PHY – Physics

PHY/EGR 101 Introduction to Engineering and Design (3 hrs.) This course introduces students to the engineering profession. Emphasis is placed on engineering design, project management skills, software applications, teamwork, and communication. An engineering term project including a written technical report is required for this course. Offered every spring semester.

PHY 105 Introduction to Physics (3 hrs.) An introductory study of the foundations and concepts of modern physical theory. The course stresses the historical significance and philosophic implications of classical mechanics, the special and general theories of relativity and quantum theory. This course is intended for non-science majors. However, students who plan to enroll in PHY 201, but who have not taken high school physics, are encouraged to take this course first. Not open to students with credit in PHY 201. This course is typically offered once per academic year in the spring semester. Prerequisites: MAT 111 or one year of high school algebra.

PHY 201 Physics I (4 hrs.) A study of the science of physics covering topics in mechanics, gravitation and rudimentary quantum physics. Lecture, three hours; laboratory, three hours. This course is offered once per academic year in the Fall semester. Prerequisites: PHY 105 or one year of high school physics and previous or concurrent enrollment in MAT 124 or one year of high school calculus.

PHY 202 Algebra-Based Physics I (4 hrs.) Algebra-based Physics I is an introductory physics course which covers the topics of Newtonian mechanics, conservation laws, and fluid statics and dynamics. The course includes a laboratory. Prerequisite: MAT 111 or one year of high school Algebra.

PHY 212 Physics II (4 hrs.) A continuation of Physics I covering topics in electromagnetism, electric circuits, waves, optics, atomic physics, nuclear physics and particle physics. Lecture three hours; laboratory three hours. This course is offered once per academic year in the spring semester. Prerequisites: Completion of PHY 201 with a C- or better.

PHY 213 Algebra-Based Physics II (4 hrs.) Algebra-based Physics II is a continuation of Algebra-based Physics I and covers the topics of oscillatory motion, waves, electricity and magnetism, optics, and selected topics in modern physics. This course includes a laboratory. Prerequisite: C- or better in Algebra-based Physics I.

PHY 223 Physics III (3 hrs.) A continuation of Physics II covering topics that require a command of calculus and more abstract concepts than those presented in PHY 201 or 212. The course is a study of selected topics in relativity, quantum mechanics and modern physics (including elementary particles). This course is typically offered once per academic year in the fall semester. Prerequisites: PHY 212 and previous or concurrent enrollment in MAT 214.

PHY/EGR 230 Engineering Mechanics & Statics (3 hrs.) Statics is the study of rigid-body mechanics which deals with the equilibrium of bodies. Covered topics include the principles of statics, force systems, internal forces, structural analysis, friction, center of gravity, and moments of inertia. Prerequisites: MAT 224 and PHY 201 with a C- or better.

PHY 314 Thermodynamics (4 hrs.) Study of the general laws of thermodynamics, the kinetic theory of gases and statistical mechanics. Lecture three hours; laboratory three hours. Prerequisites: PHY 223 and MAT 224.

PHY 315 Modern Physics (4 hrs.) The course covers applications of quantum theory and relativity theory to atoms, molecules and subatomic particles. Lecture three hours; laboratory three hours. Prerequisites: PHY 223 and MAT 224.

PHY 324 Light (4 hrs.) A study of topics in geometrical and physical optics and in spectroscopy, including an examination of optical instruments and light sources such as lasers. Lecture three hours; laboratory three hours. This course is typically offered every other academic year in the spring semester and alternates with PHY 325. Prerequisites: PHY 223.

PHY 325 Electronics (4 hrs.) The theory of semiconductor devices and applications of these devices in circuits. The course emphasizes electronic instrumentation and experimental technique. Lecture three hours; laboratory three hours. This course typically is offered every other academic year during the spring semester and alternates with PHY 324. Prerequisites: PHY 212.

PHY 328 Analog Circuits (4 hrs.) We will investigate the theory and experimental procedures of modern electronic analog circuits. There are two main classes of electronics: analog and digital. Analog circuits, covered this semester, deals with electrical signals that can have a continuous range of values, while digital circuits, covered during the second semester of the circuits sequence, involves digital signals that can have only a small number of discrete values. Prerequisites: PHY 212 and MAT 214.

PHY 398 Independent Study (1-4 hrs.) On topics from the major areas of physics, chosen according to the background, requirements, or interests of the individual student. Course work will consist of readings, problem solving, laboratory research, practicums, reports or conferences, as appropriate.

PHY 415 Introduction to Theoretical Physics I (4 hrs.) Vector analysis is developed as a working tool and applied to problems in mechanics and electromagnetic theory. The topics covered include statics, kinematics and dynamics of particles and rigid bodies, moments of inertia and inertia tensors, work and energy, gravitational theory, oscillations and electric and magnetic fields in vacuo and in material substances. Four lectures per week. This course is offered as needed. Prerequisites: PHY 223, MAT 224 and previous or concurrent enrollment in MAT 312.

PHY 416 Introduction to Theoretical Physics II (4 hrs.) Vector analysis is developed as a working tool and applied to problems in electromagnetic theory and quantum mechanics. The topics covered include Maxwell's equations and time-dependent fields, energy and forces associated with these fields, wave propagation and the postulates of quantum mechanics, wave functions, expectation values and the quantization of angular momentum in atoms. Four lectures per week. This course is offered as needed. Prerequisites: PHY 223, MAT 224 and previous or concurrent enrollment in MAT 312.