

# DEPARTMENT OF PHYSICAL SCIENCE AND APPLIED MATHEMATICS

## Department websites

- h (<https://www.vanguard.edu/academics/academic-programs/undergrad/psam/computer-science-bs/>)<https://www.vanguard.edu/academics/academic-programs/undergrad/psam/computer-science-bs/> (<https://catalog.vanguard.edu><https://www.vanguard.edu/academics/academic-programs/undergrad/psam/computer-science-bs/>)
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*Mission: In keeping with the mission of a liberal arts education, we aim not to simply teach students the central concepts of the physical sciences and mathematics, but to foster in them the ability and desire to think critically, reason logically and empirically, express clearly, and connect ideas creatively. We are dedicated to preparing students for a successful career or graduate education in fields that are constantly evolving. As a Christian Liberal Arts university, our mission is to do this while helping students cultivate character and deepen their faith. Through its own unique approach, each program gives students the opportunity to discover God's physical world and thereby enlarge their Christian worldview.*

All majors in PSAM are expected to make satisfactory academic progress toward graduation. In addition to the requirements established by the University, students must maintain a 2.0 in all major coursework. Further, the Department also requires a minimum grade of C- as completion for pre-requisites in science-related coursework for all students enrolled in MATH, BIOL, ENVR, CHEM, and PSCI courses, regardless of major.

## Programs

### Majors:

- Computer Science B.S. (<https://catalog.vanguard.edu/cas/mathematics-physical-sciences/computer-science-bs/>)
- Engineering Physics B.S. (<https://catalog.vanguard.edu/cas/mathematics-physical-sciences/engineering-physics-bs/>)

### Minors:

- Minor in Chemistry (<https://catalog.vanguard.edu/cas/mathematics-physical-sciences/chemistry-minor/>)
- Minor in Mathematics (<https://catalog.vanguard.edu/cas/mathematics-physical-sciences/mathematics-minor/>)

## Courses Chemistry

### CHEM-112C Fundamentals of General, Organic, and Biochemistry I 3 Credits

An introduction to the study of matter and properties. The course surveys in one semester chemical topics such as: atomic theory, periodic trends, measurements and stoichiometry, chemical reactions, reduction and oxidation chemistry, chemical equilibrium, nuclear chemistry acids and bases. This course is designed for students who need a refresher in general chemistry. It also serves as an excellent introductory course for students in the health sciences or as a general science for non-majors. Course fulfills Core education laboratory science requirement. Lecture three hours.

Co-Requisite: Concurrent: CHEM-112CL

Terms Typically Offered: On Demand.

### CHEM-112CL Fundamentals of General, Organic, and Biochemistry I Lab 1 Credit

A complementary laboratory course to CHEM-112C emphasizing the study of matter and properties. This hands-on course teaches basic techniques used in the chemistry lab. Sample experiments include: separation of compounds, chemical precipitation reactions, oxidation-reduction reactions, household chemical qualitative analysis. Laboratory three hours. Lab fee.

Co-Requisite: Concurrent: CHEM-112C

Terms Typically Offered: On Demand.

### CHEM-113 Fundamentals of General, Organic, and Biochemistry I 3 Credits

A continuation of the study of matter and its properties. This course explores the following areas of chemistry: Organic Chemistry and Biochemistry. Topics such as: organic functional groups, basic organic reactions, biomolecular structure, metabolism, protein synthesis, and instrumentation will be covered. This course is designed for students in the health sciences, liberal studies, or as a general science for non-majors. Lecture three hours.

Prerequisite: CHEM-112C or permission of instructor.

Terms Typically Offered: On Demand.

### CHEM-113L Fundamentals of General, Organic, and Biochemistry II Lab 1 Credit

A complementary laboratory course for CHEM 113. This course implements the following experiments: organic synthesis of aspirin or other analgesics, synthesis of esters, separation of compounds using chromatographic techniques, synthesis of organic dyes, combustion of carbohydrates, analysis of proteins and DNA. This course is designed for students in the health sciences, liberal studies, or as a general science for non-majors. Laboratory three hours. Lab fee.

Prerequisite: CHEM-112CL or permission of instructor.

Co-Requisite: CHEM-113

Terms Typically Offered: On Demand.



**CHEM-120 General Chemistry I 3 Credits**

Fundamental concepts including chemical reactions, stoichiometry, atomic structure, chemical bonding, changes in state, and the periodic table. This course is intended for those students that intend to pursue graduate education in a science or health science field. A minimum of high school Algebra II and one high school chemistry course is recommended. Three hours lecture per week.

Co-Requisite: CHEM-120L

Pre- or Co-Requisite: CHEM-112C, CHEM-210C or passing score on the Chemistry Placement Exam.

Terms Typically Offered: Fall and Spring.

**CHEM-120L General Chemistry I Lab 1 Credit**

Students will learn introductory laboratory techniques such as observation, measurement, separations, and identification of reactions. Experiments will involve concepts including: atomic structure, chemical bonding, changes in state, periodic table, oxidation, kinetics, equilibrium, thermodynamics, and electrochemistry. One 4-hour laboratory session per week. Lab fee.

Prerequisite: CHEM-112CL or CHEM-210CL

Co-Requisite: CHEM-120

Terms Typically Offered: Fall and Spring.

**CHEM-121 General Chemistry II 3 Credits**

Fundamental concepts including kinetics, equilibrium, thermodynamics, and electrochemistry. Special topics will include nuclear chemistry, transition metal periodicity and coordination compounds. Three hours lecture per week.

Prerequisite: CHEM-120

Co-Requisite: CHEM-121L

Terms Typically Offered: Fall, Spring, and Summer.

**CHEM-121L General Chemistry II Lab 1 Credit**

Students will continue their introduction to laboratory techniques including gravimetric and volumetric analysis, neutralization, and catalysis. Experiments will involve the concepts including: atomic structure, chemical bonding, changes in state, periodic table, oxidation, kinetics, equilibrium, thermodynamics, and electrochemistry. One 4-hour laboratory session per week. Lab fee.

Prerequisite: CHEM-120L

Co-Requisite: CHEM-121

Terms Typically Offered: Fall, Spring, and Summer.

**CHEM-210 Integrated Chemistry 4 Credits**

This course is designed to give beginning students who have not had prior exposure to chemistry a basic overview in general, organic, and biochemistry. The following topics will be surveyed: matter and energy, atomic theory, stoichiometry, nomenclature, the periodic table, atomic structure, gas liquid and solid states, solutions, nuclear chemistry, functional groups, alkanes, alkenes, alcohols, ethers, aldehydes, ketones, amines, carboxylic acids, lipids, carbohydrates, amino acids, proteins, nucleic acids, metabolism and respiration, photosynthesis, transcription, translation, kinetics, and DNA replication. Upon completion of this integrated chemistry course, the student will have an understanding of basic principles paramount to the study of chemistry, a proficiency with stoichiometry (as it relates to the nursing discipline), writing and interpreting chemical formulas, DNA replication, transcription and translation. In addition, the student should develop an appreciation for the importance of chemistry in other disciplines. (Meets Chemistry requirement for RN to BSN students; meets Science/Lab requirement for Professional Studies students). (School for Professional Studies Course). Terms Typically Offered: Fall and Spring.

**CHEM-210C Integrated Chemistry 4 Credits**

This course is designed to give beginning students who have not had prior exposure to chemistry a basic overview in general, organic, and biochemistry. The following topics will be surveyed: matter and energy, atomic theory, stoichiometry, nomenclature, the periodic table, atomic structure, gas liquid and solid states, solutions, nuclear chemistry, functional groups, alkanes, alkenes, alcohols, ethers, aldehydes, ketones, amines, carboxylic acids, lipids, carbohydrates, amino acids, proteins, nucleic acids, metabolism and respiration, photosynthesis, transcription, translation, kinetics, and DNA replication. Upon completion of this integrated chemistry course, the student will have an understanding of basic principles paramount to the study of chemistry, a proficiency with stoichiometry (as it relates to the nursing discipline), writing and interpreting chemical formulas, DNA replication, transcription and translation. In addition, the student should develop an appreciation for the importance of chemistry in other disciplines. Meets the CORE Science Requirement for the traditional undergraduate student when taken with CHEM-201CL.

Co-Requisite: CHEM-210CL

Terms Typically Offered: Fall and Spring.

**CHEM-210CL Integrated Chemistry Laboratory 1 Credit**

A complementary laboratory course to CHEM-210C emphasizing the study of matter and properties. This hands-on course teaches basic techniques used in the chemistry lab. Sample experiments include: separation of compounds, chemical precipitation reactions, oxidation-reduction reactions, household chemical qualitative analysis. Further, the organic synthesis of aspirin or other analgesics, synthesis of esters, separation of compounds using chromatographic techniques, synthesis of organic dyes, combustion of carbohydrates, analysis of proteins and DNA are performed. This course is designed for students in the health sciences, liberal studies or as a general science for non-majors. This course fulfills the LAB CORE science requirement. Laboratory three hours. Lab fee.

Co-Requisite: CHEM-210

Terms Typically Offered: Fall and Spring.



**CHEM-212 Teaching Chemistry I 2 Credits**

This course will cover the design of chemistry laboratory experiments to demonstrate and foster the understanding of important chemical principles. Students will both design experiments and analyze experiments from a standard experimental text to determine which principles the experiment is designed to demonstrate. Particular attention will be paid to issues of safety both in the execution of an experiment and in the determination of its suitability for student involvement. In addition to three hours of lab per week, three mandatory visitations to a 6th-12th grade chemistry class per semester (at a public school) will be required. The students will provide oral and written reports on their experiences in the field visitations. Two semester sequence. Lab fee.

Prerequisite: CHEM-121 and CHEM-121L

Co-Requisite: EDUC-315

Terms Typically Offered: On Demand.

**CHEM-214 Teaching Chemistry II 2 Credits**

This course will cover the design of chemistry laboratory experiments to demonstrate and foster the understanding of important chemical principles. Students will both design experiments and analyze experiments from a standard experimental text to determine which principles the experiment is designed to demonstrate. Particular attention will be paid to issues of safety both in the execution of an experiment and in the determination of its suitability for student involvement. In addition to three hours of lab per week, three mandatory visitations to a 6th-12th grade chemistry class per semester (at a public school) will be required. The students will provide oral and written reports on their experiences in the field visitations. Two semester sequence. Lab fee.

Prerequisite: CHEM-121 and CHEM-121L

Co-Requisite: EDUC-315

Terms Typically Offered: On Demand.

**CHEM-252 Analytical Chemistry 3 Credits**

The theory of and techniques for calculations pertaining to classical gravimetric and volumetric methods, theory and techniques of separation, and an introduction to instrumental methods. Three hours lecture per week. Offered in alternate years.

Prerequisite: CHEM-120

Co-Requisite: CHEM-252L

Terms Typically Offered: Fall, even years.

**CHEM-252L Analytical Chem Techniques 1 Credit**

Laboratory experiments in classical gravimetric and volumetric methods, techniques of separation, and an introduction to instrumental methods. One four-hour laboratory session per week. Lab fee. Offered in alternate years.

Prerequisite: CHEM-120L

Co-Requisite: CHEM-252

Terms Typically Offered: Fall, even years.

**CHEM-304 Organic Chemistry I 3 Credits**

This course is designed to introduce students to organic chemistry. The following topics will be covered: bonding and atomic theory, nomenclature, stereochemistry, functional groups, substitution reactions, elimination reactions, and both electrophilic addition and aromatic substitution reactions. Students will develop a mastery of organic functional groups and nomenclature, an understanding of basic organic reaction mechanisms, a familiarity with common organic reactions, and an appreciation for the importance of organic chemistry in other disciplines. The student will be prepared to continue their education in organic chemistry in the sequential course (CHEM-305). Three hours of lecture per week.

Prerequisite: CHEM-121

Co-Requisite: CHEM-304L

Terms Typically Offered: Fall and Summer.

**CHEM-304L Organic Chemistry Techniques I 1 Credit**

This is the complementary laboratory course for CHEM-304. This course is designed to develop basic skills and techniques for practical application of the general principles of organic chemistry. The development of a safe approach to lab experimentation will be stressed. Four-hour laboratory session per week. Lab fee.

Prerequisite: CHEM-121L

Co-Requisite: CHEM-304

Terms Typically Offered: Fall and Summer.

**CHEM-305 Organic Chemistry II 3 Credits**

This course is designed as a continuation of the study of organic chemistry. Students will be introduced to various topics in organic chemistry including: organic oxidations and reductions, carbonyl chemistry, amines, carboxylic acids and their derivatives, organic mechanisms and various biological molecules and building blocks. Three hours of lecture per week.

Prerequisite: CHEM-304 and CHEM-304L

Co-Requisite: CHEM-305L

Terms Typically Offered: Spring and Summer.

**CHEM-305L Organic Chemistry Technqs II 1 Credit**

This is the complementary laboratory course for CHEM-305. This course is designed to develop basic skills and techniques for practical application of the general principles of organic chemistry including identification of unknowns and multi-step synthesis. The development of a safe approach to lab experimentation will be stressed. Four-hour laboratory session per week. Lab fee.

Prerequisite: CHEM-304 and CHEM-304L

Co-Requisite: CHEM-305

Terms Typically Offered: Spring and Summer.

**CHEM-309 Literature and Spectroscopy 2 Credits**

This course is designed for transfer students who have previously taken Organic Chemistry 1 and 2 at other institutions. This course introduces basic spectroscopic techniques of organic chemistry and biochemistry: IR, 1D and 2D NMR spectrometry, and MS with some discussion of UV/visible spectrophotometry. Collection and multi-spectral identification of organic compounds is emphasized. Additionally this course includes a survey of chemical literature and methods of its use with emphasis on locating specific chemical information in primary and secondary literature. One hour of lecture and two hours of lab per week. Lab Fee.

Prerequisite: CHEM-304 and CHEM-304L

Terms Typically Offered: On Demand.



**CHEM-325 History & Philosophy of Science 3 Credits**

Study of selected topics in the history and philosophy of science and the application of these principles in analyzing contemporary scientific trends. Especially recommended for liberal studies majors and those planning to teach physical or biological sciences in secondary schools. Three hours of lecture per week.

Prerequisite: BIOL-121 or BIOL-131; CHEM-121; and PSYCI-223C, PSCI-225, or equivalent.

Terms Typically Offered: On Demand.

**CHEM-430 Biochemistry 3 Credits**

This course covers topics at the interface of chemistry and biology. Topics include: the chemistry, structure, properties, and function of proteins, carbohydrates, nucleic acids and lipids; enzyme catalysis; membranes; transport; bioenergetics and carbohydrate metabolism. Three hours of lecture per week.

Prerequisite: CHEM-305 and CHEM-305L

Co-Requisite: CHEM-430L

Terms Typically Offered: Fall.

**CHEM-430L Experimental Tech/Biochemistry 1 Credit**

This is the complementary laboratory course for CHEM-430. This course is designed to enhance the basic skills and techniques learned in the previous foundational experimental chemistry courses. This course focuses on modern biochemical techniques including the operation of chromatographic and spectroscopic instruments used in the practical application biological chemistry. The development of a safe approach to lab experimentation will be stressed. Four-hour laboratory session per week. Lab fee. Offered in alternate years.

Prerequisite: CHEM-305 and CHEM-305L

Co-Requisite: CHEM-430

Terms Typically Offered: Fall.

**CHEM-435 Advanced Biochemistry 3 Credits**

Advanced Biochemistry provides an in depth view of bioenergetics, catabolism, and biosynthesis. Topics include: carbohydrate, lipid, amino acid, DNA, RNA and protein metabolism; photosynthesis, the structure of genetic material; regulation of metabolism and gene expression. Three hours of lecture per week.

Prerequisite: CHEM-430

Terms Typically Offered: Spring, odd years.

**CHEM-440 Instrumental Analysis 2 Credits**

An introduction to modern instrumental chemical analysis. The course will span theory of operation, instrument design and methodology, and applications of instrumental techniques. Electrochemical methods including potentiometry, voltammetry, and coulometry; spectroscopic methods including infrared, UV-Vis, and NMR; chromatographic methods including gas, liquid and thin layer; and thermal methods of analysis and kinetic methods of analysis will be covered.

Prerequisite: CHEM-252

Terms Typically Offered: Fall, odd years.

**CHEM-440L Instrumental Analysis Lab 2 Credits**

Introduces students to the major concepts of instrumental analysis and to some of the instrumental techniques most commonly used in analytical and bioanalytical chemistry. It emphasizes the use of modern, commercial instrumentation to perform quantitative and qualitative analyses of the physical properties and chemical composition of samples. Laboratory Course for 8 hours. Lab fee.

Prerequisite: CHEM-252L

Co-Requisite: CHEM-440

Terms Typically Offered: Fall, odd years.

**CHEM-450 UG Research Or Internship Program 1-4 Credits**

Prerequisite: Open to juniors and seniors. This course may be taken for a maximum of 4 units in one semester. A maximum of 6 combined units credit for CHEM-450 or CHEM-485 apply to graduation. This course is designed with the purpose of providing students the opportunity to conduct research off-campus at universities or STEM companies in the community. This course promotes early entry into the workplace for the student through part-time employment. This course requires actual work experience be sought in a biotech or STEM-focused business firm providing an opportunity to integrate classroom teaching in practical application under the direct supervision of the assigned instructor. Students are responsible for completing a project report and presenting their research results in CHEM-499C.

Prerequisite: CHEM-121

Terms Typically Offered: Fall and Summer.

**CHEM-455 Chemistry Teaching Internship 1-3 Credits**

Regular hours each week for classes and/or meetings are established at the beginning of the semester. The intern assists an instructor in planning and conducting a course, and/or laboratory sessions. This course may be taken for 1-3 units per semester. May be repeated for a maximum of six units.

Terms Typically Offered: Fall and Spring.

**CHEM-456 Physical Chemistry: Thermodynamics 2 Credits**

Laws, principles and concepts of chemistry concerning the properties of gases, the laws of thermodynamics, the theory and equations of phase changes in both pure and mixed substances, chemical equilibrium, equilibrium electrochemistry. Two hours lecture per week. Offered in alternate years.

Prerequisite: CHEM-121, MATH-181; MATH-281 preferred.

Terms Typically Offered: Fall, odd years.

**CHEM-456L Physical Chemistry Technique Lab 1-2 Credits**

When taken for one unit, experiments involving the properties of gases, the laws of thermodynamics, the theory and equations of phase changes in both pure and mixed substances, chemical equilibrium, equilibrium electrochemistry, molecular motion and diffusion, and both classical and molecular chemical kinetics. When taken for two units, additional experiments involving: quantum properties of atoms and molecules; electrical properties of atoms and molecules; rotational, vibrational, and electronic spectroscopy; statistical-mechanical analysis of the thermodynamic and phase change properties of atoms and molecules; and the physical chemistry of macromolecules. Formal journal-style reporting required. Four to eight hours laboratory per week. Lab fee per unit.

Prerequisite: CHEM-252 and CHEM-252L

Terms Typically Offered: Spring, even years.



**CHEM-457 Physical Chemistry: Kinetics 2 Credits**

Laws, principles and concepts of chemistry concerning molecular motion and diffusion, both classical and molecular chemical kinetics, and introductory statistical mechanics. Two hours lecture per week. Offered in alternate years.

Prerequisite: CHEM-121, Math-181; MATH-281 preferred.

Terms Typically Offered: Spring, even years.

**CHEM-458 Physical Chemistry: Quantum Mechanics 2 Credits**

Laws, principles, and concepts of chemistry concerning: quantum mechanics; quantum properties of atoms and molecules; symmetry of molecules; rotational, vibrational, electronic, and magnetic (nuclear) spectroscopy and introductory statistical mechanics. Two hours lecture per week. Offered in alternate years.

Prerequisite: CHEM-457, MATH-281

Terms Typically Offered: Spring, even years.

**CHEM-460 Physical Chemistry I 3 Credits**

Laws, principles and concepts of chemistry concerning the properties of gases, the laws of thermodynamics, the theory and equations of phase changes in both pure and mixed substances, chemical equilibrium, equilibrium electrochemistry, molecular motion and diffusion, both classical and molecular chemical kinetics. Three hours lecture per week. Offered in alternate years.

Prerequisite: CHEM-121, CHEM-252, and MATH-180C

Co-Requisite: CHEM-460L

Terms Typically Offered: Fall, odd years.

**CHEM-460L Physical Chemistry Lab 1 Credit**

Experiments involving the properties of gases, the laws of thermodynamics, the theory and equations of phase changes in both pure and mixed substances, chemical equilibrium, equilibrium electrochemistry, molecular motion and diffusion, and classical chemical kinetics. Formal journal-style reporting required. Four hours laboratory per week. Lab fee.

Prerequisite: CHEM-121L and CHEM-252L

Co-Requisite: CHEM-460

Terms Typically Offered: Fall, odd years.

**CHEM-461 Physical Chemistry II 3 Credits**

Laws, principles and concepts of chemistry concerning quantum mechanics; quantum properties of atoms and molecules; symmetry of molecules; rotational, vibrational, electronic, and magnetic (nuclear) spectroscopy; and introductory statistical mechanics. Three hours lecture per week. Offered in alternate years.

Prerequisite: CHEM-252, MATH-181, MATH-281

Terms Typically Offered: Spring, even years.

**CHEM-470 Special Topic: 1-4 Credits**

Study in a special topic in chemistry. May be repeated for credit. May have a lab fee. Topics may include advanced inorganic chemistry, rates and mechanisms in organic chemistry, synthetic methods in organic chemistry, or other advanced topics.

Terms Typically Offered: On Demand.

**CHEM-480 Individual Studies: 1-4 Credits**

Terms Typically Offered: On Demand.

**CHEM-485 Undergraduate Research 1-4 Credits**

Problems in advanced laboratory research with emphasis on research techniques. Research is carried out under the supervision of the instructor with weekly conferences to discuss results and direction. Emphasis will be placed on project management, safety, instrumentation, solution preparation, and research documentation skills. A written proposal and report emphasizing the literature background of the problem and the experimental results are required. The results of the research project will also be presented in an oral format in CHEM-499C. This course is a variable credit course. At least two units are required for all chemistry and biochemistry majors. A minimum of 50 hours of laboratory work is required per unit. May be repeated. Lab fee.

Terms Typically Offered: Fall and Summer.

**CHEM-488 Chemistry Senior Project 2 Credits**

An advanced course providing the opportunity for a student to create a novel and independent intellectual work by comparing, contrasting, and synthesizing recent research and his/her cumulative knowledge and understanding in Chemistry. The precise nature, scope and format of the project must be developed and approved under the guidance of the instructor and in collaboration with the student's academic advisor. Senior projects are typically initiated in the Fall. The project results must also be presented in CHEM-499C. Lab fee.

**CHEM-499C Chemistry Capstone Seminar 2 Credits**

This course includes a senior thesis covering an approved research topic, analysis and evaluation of current research in chemistry, and the integration of faith and the chemical sciences. An oral presentation of the senior thesis in a classroom setting is required. In-class presentations by faculty and guests are part of the course. Laboratory research in an on-campus research program or an approved off-campus research program may be required for the senior thesis. This course fulfills the Core Curriculum Capstone requirement for Chemistry majors.

Terms Typically Offered: Spring.

## Computer Sciences

**CSCI-110C Introduction to Computer Science 4 Credits**

Introductory course in computer science and the study of algorithms appropriate for students in data-intensive disciplines. Topics include how computers work, simple algorithms and their efficiency, problem solving methods, networking, databases, security and the social impact of computing. Students will be introduced to an object-oriented programming language: Python.

Terms Typically Offered: Fall and Spring.

**CSCI-205 Cybersecurity 3 Credits**

This course will provide a basic introduction to of all aspects of cybersecurity including business, policy and procedures, communications security, network security, security management, legal issues, political issues, and technical issues. This serves as the introduction to the cyber security track in the computer science program."

Prerequisite: CSCI-110C

Terms Typically Offered: Spring, odd years.



**CSCI-208 Java Programming 4 Credits**

This course is designed to familiarize the student with programming as an activity and coding in the Java language in particular. It will also serve as an introduction to object-oriented programming in general. Topics covered will include: data types and operators; flow control statements; classes, objects, and methods; inheritance; packages and interfaces; exception handling; and input/output.

Prerequisite: CSCI-110C

Terms Typically Offered: Spring.

**CSCI-216 Introduction to Web Programming 3 Credits**

Explores front-end web development technologies and techniques with a focus on HTML, CSS, JavaScript and supporting libraries and frameworks. Students should be familiar with basic programming and database concepts prior to taking this course. Topics include database design, scalability, security, and user experience. Through hands-on projects, you'll learn to write and use APIs, create interactive UIs, and leverage cloud services. By course's end, students will emerge with knowledge and experience in principles, languages, and tools that empower them to design and deploy applications on the Internet.

Prerequisite: CSCI-110C

Terms Typically Offered: Spring, odd years.

**CSCI-217 Database Systems 1 3 Credits**

This course covers the fundamental concepts of database systems. Topics include data models (ER, relational, and others); query languages (relational algebra, SQL, and others); implementation techniques of database management systems (index structures, concurrency control, recovery, and query processing); management of semistructured and complex data; distributed and noSQL databases.

Prerequisite: CSCI-208 or CSCI-218

Terms Typically Offered: Fall, even years.

**CSCI-218 Python Programming 4 Credits**

Introduction to programming basics (what it is and how it works), binary computation, problem-solving methods and algorithm development. Includes procedural and data abstractions, program design, debugging, testing, and documentation. Covers data types, control structures, functions, parameter passing, library functions, arrays, inheritance and object oriented design. Lecture Lab Combination. Laboratory exercises in Python.

Prerequisite: CSCI-110C

Terms Typically Offered: Fall, odd years.

**CSCI-270 Special Topic in Computer Science 3 Credits**

Terms Typically Offered: On Demand.

**CSCI-302 Algorithm Design and Applications 3 Credits**

This is an intermediate algorithms course with an emphasis on teaching techniques for the design and analysis of efficient algorithms, emphasizing methods of application. Topics include divide-and-conquer, randomization, dynamic programming, greedy algorithms, incremental improvement, complexity, and cryptography.

Prerequisite: MATH-375

Terms Typically Offered: Fall, even years.

**CSCI-305 Programming Languages 3 Credits**

This course covers the basic concepts and design tradeoffs of programming languages. Examine different languages and compare their properties as well as the cost-benefits of different implementations. The first half of the course focuses on functions, types, scope, storage management, exceptions, and continuations. The second half covers object-oriented features and concurrency.

Prerequisite: CSCI-208 or CSCI-340

Terms Typically Offered: Fall, odd years.

**CSCI-309 Network Security and Digital Crime 3 Credits**

This course provides an introduction to the methodology and procedures associated with digital forensic analysis in a network environment. Students will develop an understanding of the fundamentals associated with the topologies, protocols, and applications required to conduct forensic analysis in a network environment. Students will learn about the importance of network forensic principles, legal considerations, digital evidence controls, and documentation of forensic procedures. This course will incorporate demonstrations and laboratory exercises to reinforce practical applications of course instruction and will require an independent research paper related to the course topic.

Prerequisite: CSCI-205

Terms Typically Offered: Spring, even years.

**CSCI-317 Data Structures 4 Credits**

This course investigates abstract data types (ADTs), recursion, algorithms for searching and sorting, and basic algorithm analysis. ADTs to be covered include lists, stacks, queues, priority queues, trees, sets, and dictionaries. The emphasis is on the trade-offs associated with implementing alternative data structures for these ADTs.

Prerequisite: MATH-181C and CSCI-208

Terms Typically Offered: Spring, even years.

**CSCI-320 Digital Forensics and Investigation 3 Credits**

This course is an overview of the principles and practices of digital investigation. Fundamentals and the importance of digital forensics is emphasized. Students learn different techniques and procedures that enable them to perform a digital investigation with a primary focus on the analysis of physical storage media and volume analysis. It covers the major phases of digital investigation such as preservation, analysis and acquisition of artifacts that reside in hard disks and random-access memory. Upon completion of the course, students will be able to apply open-source forensics tools to perform digital investigations and understand the underlying theory behind these tools.

Prerequisite: CSCI-110C

Terms Typically Offered: Spring, even years.

**CSCI-325 Introduction to Networks 3 Credits**

An introduction to the design and analysis of computer communication networks. Topics include application layer protocols, Internet protocols, network interfaces, local and wide area networks, wireless networks, bridging and routing, and current topics. Lecture.

Prerequisite: CSCI-110C and MATH-180C

Terms Typically Offered: Fall, odd years.



**CSCI-330 Introduction to Operating Systems 3 Credits**

This course will introduce modern operating systems. The course will begin with an overview of the structure of modern operating systems. And then will analyze in detail each of the major components of an operating system (from processes to threads), and explore more advanced topics in the field, including memory management and file input/output. Covers the classical internal algorithms and structures of operating systems, including CPU scheduling, memory management, and device management. Considers the unifying concept of the operating system as a collection of cooperating sequential processes. Covers topics including file systems, virtual memory, disk request scheduling, concurrent processes, deadlocks, security, and integrity. The focus is on UNIX-based operating systems, though learning will also cover alternative operating systems, including Windows. Lecture, 3 hours. A complementary lab course allows students to practice and implement topics from lecture.

Prerequisite: CSCI-208

Terms Typically Offered: Fall, even years.

**CSCI-401 Database Systems 1 3 Credits**

This course covers the fundamental concepts of database systems. Topics include data models (ER, relational, and others); query languages (relational algebra, SQL, and others); implementation techniques of database management systems (index structures, concurrency control, recovery, and query processing); management of semistructured and complex data; distributed and noSQL databases.

Prerequisite: CSCI-317 and CSCI-302

Terms Typically Offered: Fall, even years.

**CSCI-411 Software Engineering 1 3 Credits**

Learn how to apply an engineering approach to computer software design and development by focusing on topics like life cycle models, software requirements, specification, conceptual model design, detailed design, validation and verification, design quality assurance, software design/development environments, and project management.

Prerequisite: CSCI-302, CSCI-317, and CSCI-415

Terms Typically Offered: Spring, odd years.

**CSCI-415 Computer Architecture 3 Credits**

Modern computer technology requires an understanding of both hardware and software, since the interaction between the two offers a framework for mastering the fundamentals of computing. The purpose of this course is to cultivate an understanding of modern computing technology through an in-depth study of the interface between hardware and software. An overview of computer architecture, which stresses the underlying design principles and the impact of these principles on computer performance will be surveyed. General topics include design methodology, processor design, control design, memory organization, system organization, and parallel processing. Lecture, 3 hours. A complementary lab course allows students to practice and implement topics from lecture.

Prerequisite: CSCI-208 and CSCI-330

Terms Typically Offered: Fall, even years.

**CSCI-425 Computing Theory 3 Credits**

The goal of this course is to understand the fundamental limits on what can be efficiently computed in our universe and other possible universes. These limits reveal deep and mysterious properties about information, knowledge, and processing, as well as practical issues about what can and cannot be computed. The course introduces the foundations of automata theory, computability theory, and complexity theory. Shows relationship between automata and formal languages. Addresses the issue of which problems can be solved by computational means (decidability vs undecidability), and introduces concepts related to computational complexity of problems. Lecture, 3 hours.

Prerequisite: CSCI-302, CSCI-317, and MATH-285

Terms Typically Offered: Spring, odd years.

**CSCI-450 Ug Research Internship Program 1-4 Credits**

This course may be taken for a maximum of four (4) units in one semester. A maximum of six (6) combined unit credits for CSCI-450 or CSCI-485 apply to graduation. This course is designed with the purpose of providing students the opportunity to conduct research off-campus at universities or companies in the community. This course promotes early entry into the workplace for the student through part-time employment. This course requires actual work experience be sought in an appropriate business firm providing an opportunity to integrate classroom teaching in practical application under the direct supervision of the assigned instructor. Students are responsible for completing a project report and presenting their research results in CSCI-499C. Registration is limited to juniors or seniors.

Terms Typically Offered: On Demand.

**CSCI-470 Special Topic in Computer Science 3 Credits**

Terms Typically Offered: On Demand.

**CSCI-485 Undergraduate Computer Science Research 1-4 Credits**

This course provides the student with an empirically-based research experience in the computer sciences. Emphasis will be placed on project management, software development, and research documentation skills. This course is a variable credit course. Two units are recommended for all computer science majors. It is expected that a research report be completed at the conclusion of the research project and an oral presentation of the results be given in CSCI-499C. This course may be repeated for credit. Lab fee.

Terms Typically Offered: Summer.

**CSCI-499C Computer Science Capstone 3 Credits**

This course includes analysis and evaluation of current research in computer sciences and the integration of faith and learning in the computer sciences. A senior project and an oral presentation of this project is required. In-class presentations by faculty and guests are a part of the course. This course fulfills the Core Curriculum Capstone requirement for Computer Science majors.

Prerequisite: CSCI-411

Terms Typically Offered: Spring.



## Data Science

### DSCI-200 Introduction to Data Science 4 Credits

This course will introduce students to this rapidly growing field and equip them with some of its basic principles and tools as well as its general mindset. Students will learn the concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration, exploratory data analysis, predictive modeling, descriptive modeling, data product creation, evaluation and effective communication. A laboratory component will be included.

Prerequisite: CSCI-208 or CSCI-218

Terms Typically Offered: Fall, odd years.

### DSCI-350 Data Mining 3 Credits

Recommended CSCI-340. Data Mining studies algorithms and computational paradigms that allow computers to find patterns and regularities in databases, perform prediction and forecasting, and generally improve their performance through interaction with data. It is currently regarded as the key element of a more general process called Knowledge Discovery that deals with extracting useful knowledge from raw data. The knowledge discovery process includes data selection, cleaning, coding, using different statistical and machine learning techniques, and visualization of the generated structures. The course will cover all these issues and will illustrate the whole process by examples. Special emphasis will be given to the Machine Learning methods as they provide the real knowledge discovery tools. Important related technologies such as data warehousing and online analytical processing (OLAP), will be also discussed. The students will use recent Data Mining software.

Terms Typically Offered: Spring, even years.

### DSCI-410 Data Visualization 3 Credits

Visualization is increasingly important in this era where the use of data is growing in many different fields. Data visualization techniques allow people to use their perception to better understand this data. The goal of this course is to introduce students to data visualization including both the principles and techniques. Students will learn the value of visualization, specific techniques in information visualization and scientific visualization, and understand how best to leverage visualization methods.

Prerequisite: DSCI-350

Terms Typically Offered: Fall, odd years.

### DSCI-415 Experimental Design, Statistical Analysis 3 Credits

Introduces advanced statistical concepts and analytical methods for the experimental needs and data encountered in computer, data and physical sciences. Experimental design/conduct, quantitative analysis of data, and statistical inferences and interpretations are studied for scientific hypothesis testing, as well as clinical trials. Explores methodological approaches to bioassay development/testing and provides a foundation for critically evaluating information to support research findings, product claims, and technology opportunities. Students apply statistical analysis software and write algorithms in programming languages commonly used in technology and professional science industries (ie. Python). Topics include statistical tools such as Bayesian statistics, Markov processes, and information theoretic indices.

### DSCI-450 Ug Research Internship Program 1-4 Credits

This course may be taken for a maximum of four (4) units in one semester. A maximum of six (6) combined unit credits for DSCI-450 or DSCI-485 apply to graduation. This course is designed with the purpose of providing students the opportunity to conduct research off-campus at universities or companies in the community. This course promotes early entry into the workplace for the student through part-time employment. This course requires actual work experience be sought in an appropriate business firm providing an opportunity to integrate classroom teaching in practical application under the direct supervision of the assigned instructor. Students are responsible for completing a project report and presenting their research results in DSCI-499C

Terms Typically Offered: Summer.

### DSCI-485 Undergraduate Data Science Research 1-4 Credits

This course provides the student with an empirically-based research experience in the data sciences. Emphasis will be placed on project management, software development, and research documentation skills. This course is a variable credit course. Two units are recommended for all data science majors. It is expected that a research report be completed at the conclusion of the research project and an oral presentation of the results be given in DSCI-499C. This course may be repeated for credit. Lab fee.

Terms Typically Offered: Summer.

### DSCI-488 Computer Science Senior Project 2 Credits

An advanced course providing the opportunity for a student to create a novel and independent intellectual work by comparing, contrasting and synthesizing recent research and his/her cumulative knowledge and understanding in the computer sciences. The precise nature, scope and format of the project must be developed and approved under the guidance of the instructor and in collaboration with the student's academic advisor. Senior projects are typically initiated in the Fall. The project results must also be presented in DSCI-499C.

Terms Typically Offered: Fall.

### DSCI-499C Capstone Seminar in DSCI 2 Credits

This course includes analysis and evaluation of current research in the data sciences and the integration of faith and learning in the data sciences. An oral presentation of research from DSCI 450, 485, or 488 is required. In-class presentations by faculty and guests are a part of the course. This course fulfills the Core Curriculum Capstone requirement for Data Science majors.

Prerequisite: DSCI-450 and DSCI-485

Terms Typically Offered: Spring.

## Engineering Physics

### ENGR-110 Introduction to Engineering 3 Credits

This course provides a solid foundation in fundamental skills needed for freshmen and transfer students to academically succeed and professionally prepare them for challenges within the disciplines of Engineering and Technology Management. The project-based assignments will provide students with opportunities to apply mathematics to solve engineering problems, acquire team working skills, practice written and verbal communication skills, and enhance problem solving and design skills. Early understanding of these skills will assist students throughout their undergraduate experience.

Prerequisite: MATH-180C

Terms Typically Offered: Spring, odd years.





**ENGR-201 Electric Circuits 4 Credits**

An introduction to electrical circuit components and laws, including ideal op-amps, DC circuit analysis, AC circuit analysis, transient analysis of RL and RC circuits and computer-aided circuit analysis. This course is 4 units consisting of a 3 hour lecture and 3 hour lab per week.

Prerequisite: PSCI-225 and MATH-181C

Terms Typically Offered: Spring, even years.

**ENGR-202 Engineering Dynamics 3 Credits**

Topics to be covered include vector dynamics of particles and rigid bodies. The students learn to represent and compute displacement, velocity, and acceleration of particles and rigid bodies in different coordinate systems. Further upon, they learn to relate forces and motions of particles and rigid bodies using Newton's laws and Newton-Euler equations under the conditions where the sum of the forces are not zero. Free, forced, and damped vibrations of particles and rigid bodies are presented in the end. Three hours of lecture per week.

Prerequisite: ENGR-265

Terms Typically Offered: Spring, odd years.

**ENGR-203 Digital Logic Systems 3 Credits**

This course covers the broad range of foundational skills that apply across all embedded computer system application areas, from thermostats to self-driving vehicles. The emphasis is at the layer where hardware meets software. Topics include microcontroller hardware, assembly language, embedded C programming, analog I/O, timers, code optimization, interrupts, and concurrency. Real world engineering practices, constraints, and example applications are integrated throughout the course. Weekly hands-on hardware and software experiences with an industry-strength automotive embedded controller are coordinated with the lecture content to reinforce core skill.

Prerequisite: ENGR-201

Terms Typically Offered: Fall, odd years.

**ENGR-265 Engineering Statics 3 Credits**

Topics to be covered include equivalent systems of forces, resultants and distributed forces, equilibrium of rigid bodies, centroids, centers of gravity, moments of inertia, friction and virtual work. Analysis of frames and machines, forces in beams, internal stresses, and stability. Vector algebra will be used throughout. Three hours of lecture per week.

Prerequisite: PSCI-223C and MATH-281

Terms Typically Offered: Fall, even years.

**ENGR-301 Embedded Systems 3 Credits**

This course covers the broad range of foundational skills that apply across all embedded computer system application areas, from thermostats to self-driving vehicles. The emphasis is at the layer where hardware meets software. Topics include microcontroller hardware, assembly language, embedded C programming, analog I/O, timers, code optimization, interrupts, and concurrency. Real world engineering practices, constraints, and example applications are integrated throughout the course. Weekly hands-on hardware and software experiences with an industry-strength automotive embedded controller are coordinated with the lecture content to reinforce core skills.

Prerequisite: ENGR-201 and ENGR-203

Terms Typically Offered: Spring, even years.

**ENGR-307 Computational Problem Solving 4 Credits**

While this course is designed for students with majors in the engineering and physical sciences and applied mathematics it is open to all majors.

The course will focus on scientific computing and problem-solving using MATLAB and/or similar programming tools. Topics studied include: the design of algorithms, algorithmic problem solving, abstraction, pseudocode, and iteration, important algorithms of computer science, methods used by computer scientists to classify algorithms according to their efficiencies, making predictions of execution times for algorithms, converting algorithms to programming languages such as Visual Basic, C++ and MATLAB. The course will focus on scientific computing and problem-solving using MATLAB and/or similar programming tools. The goal of the course is to design and execute computer programs using practical applications of the following: matrix algebra, and numerical integration of ordinary differential equations (ODEs). The course will also include applying the methodology for solving systems of linear and nonlinear equations and analysis of numerical results. Lab Fee.

Prerequisite: CSCI-110C and MATH-180C

**ENGR-310 Electronics I 3 Credits**

An introduction to the theory and application of electronic (analog and digital) circuits and devices. The course focuses on the analysis and building of simple electronic circuits. Topics covered include: steady state circuit analysis using complex numbers, simple time-domain analysis and circuit simulation software, semiconductor physics, junctions and transistors, amplifiers, feedback, control circuits, filters, oscillators, optoelectronic devices, electronic noise and signal to noise improvement, field effect transistors, logic gates, digital electronics, signal processing and hybrid analog/digital circuits, and AM/FM and high frequency circuits.

Prerequisite: PSCI-225

Co-Requisite: ENGR-310L

Pre- or Co-Requisite: MATH-310

Terms Typically Offered: Fall, even years.

**ENGR-310L Electronics I Lab 1 Credit**

This course supports the ENGR-310 lecture.

Prerequisite: PSCI-225L

Co-Requisite: ENGR-310

Terms Typically Offered: Fall, even years.

**ENGR-320 Optics 4 Credits**

This is an introductory Optics course with emphasis on applying lectured, theoretical principles in a hands-on setting. This course will cover the fundamental properties of light propagation and interaction with matter under the approximations of geometrical optics and scalar wave optics. In particular, topics in geometrical optics will include: ray-tracing, aberrations, lens design, apertures and stops, radiometry and photometry. Topics covered in wave optics include: basic electrodynamics, polarization, interference, wave-guiding, Fresnel and Fraunhofer diffraction, image formation, resolution.

Prerequisite: PSCI-225

Co-Requisite: ENGR-320L

Terms Typically Offered: Fall, odd years.

**ENGR-320L Optics Laboratory 1 Credit**

This course supports the ENGR-320 lecture.

Prerequisite: PSCI-225L

Co-Requisite: ENGR-320

Terms Typically Offered: Fall, odd years.

**ENGR-400 Introduction to Materials Science Engr. 3 Credits**

Topics include: 1. Atomic structure, chemical bonding, crystal structure, defects, diffusion, phase diagrams, mechanical and magnetic properties, thermal, electrical and optical behavior; 2. Correlation of the mechanical, electrical and optical properties of different material systems such as metals and alloys, ceramics, polymers to the microstructure of the material; 3. How material properties are influenced by thermal and mechanical treatments; 4. Strengthening mechanisms in materials; 5. The effects of the environment on materials and the possible failure modes of structures; 6. Application of material systems in photonics, microelectronics, and other technology fields; 7. Design limitation for metal alloys, ceramics, semiconductors and polymers; 8. Application of materials design concepts to selecting the material most suitable for a given application.

Prerequisite: PSCI-223C/PSCI-223CL, PSCI-225/PSCI-225L, CHEM-120/CHEM-120L

Co-Requisite: ENGR-400L

Terms Typically Offered: Spring, odd years.

**ENGR-400L Intro/Materials Science Laboratory 1 Credit**

This laboratory course supports the ENGR-400 lecture. Lab Fee.

Prerequisite: CHEM-121L, PSCI-225L, PSCI-227L

Co-Requisite: ENGR-400

Terms Typically Offered: Spring, odd years.

**ENGR-450 Research Internship Program 1-4 Credits**

This course may be taken for a maximum of 4 units in one semester. A maximum of 6 combined units credit for ENGR-450 or ENGR-485 apply to graduation. This course is designed with the purpose of providing students the opportunity to conduct research off-campus at universities or STEM companies in the community. This course promotes early entry into the workplace for the student through part-time employment. This course requires actual work experience be sought in an engineering or STEM-focused business firm providing an opportunity to integrate classroom teaching in practical application under the direct supervision of the assigned instructor. Students are responsible for completing a project report and presenting their research results in ENGR-499C

Prerequisite: PSCI-225

Terms Typically Offered: On Demand.

**ENGR-485 Undergraduate Research 1-4 Credits**

Problems in advanced laboratory research with emphasis on research techniques. Research is carried out under the supervision of the instructor with weekly conferences to discuss results and direction. Emphasis will be placed on project management, safety, instrumentation, solution preparation, and research documentation skills. A written proposal and report emphasizing the literature background of the problem and the experimental results are required. The results of the research project will also be presented in an oral format in ENGR-499C.

This course is a variable credit course. At least two units of ENGR-450 or ENGR-485 are required for all engineering physics majors. A minimum of 50 hours of laboratory work is required per unit. May be repeated. Lab fee.

Prerequisite: PSCI-225

Terms Typically Offered: Summer.

**ENGR-499C Engineering Physics Capstone Seminar 2 Credits**

This course analysis and evaluation of current research in engineering and physics and the integration of faith and the physical sciences. An oral presentation of the research accomplished in ENGR 450 or ENGR 485 in a classroom setting is required. In-class presentations by faculty and guests are part of the course. This course fulfills the Core Curriculum Capstone requirement for Engineering Physics majors.

Prerequisite: ENGR-450, ENGR-485

Terms Typically Offered: Spring.

## Environmental Science

**ENVR-150C Intro to Environmental Science 3 Credits**

An introductory course focusing on the scientific analysis of environmental issues. Using core concepts from physics, chemistry, biology and earth science, students will examine key issues associated with sustaining biodiversity, natural resources, environmental health, and human societies. Topics will include ecological principles; land, water and energy use; epidemiology and toxicology; air, water and solid waste pollution; ecological economics; and environmental policy, law and planning. This course fulfills the University Lab Science CORE requirement. The course has a corresponding laboratory course.

Co-Requisite: ENVR-150CL

Terms Typically Offered: Fall.

**ENVR-150CL Intro to Environmental Science Lab 1 Credit**

An introductory complementary lab course focusing on the methods of collection and analysis of environmental samples. The Environmental Science laboratory focuses on environmental issues such as climate variation, atmospheric pollution and non-point-source water pollution. The course is made up of laboratory exercises with up to two field labs. In this course, students learn to investigate the natural world through the process of the "scientific method." Lab exercises provide an opportunity to make scientific observations, ask questions, develop explanations, design experiments and gather data. The lab exercises are designed to provide a basic understanding of how scientists investigate the world and the terminology that is used. Students have the opportunity to put the lab experience into real world scientific investigation. The course culminates in a field research project. Laboratory Course for 3 hours and lab fees.

Co-Requisite: ENVR-150C

Terms Typically Offered: Fall.

**ENVR-205C Introduction to Geology 3 Credits**

An introductory course focusing on the study of the kind and arrangement of materials composing the earth's crust and the geological processes at work on and within the earth's surface. This course covers the fundamentals of geology: Rocks, minerals, geologic time, plate tectonics, earthquakes, volcanoes, surface processes, and earth resources. This course fulfills the University Lab Science CORE requirement. The course has a corresponding laboratory course.

Terms Typically Offered: Fall.

**ENVR-205CL Introduction to Geology Laboratory 1 Credit**

Corresponding laboratory for identification of rocks and minerals. Introduction to topographic maps and how they are used to interpret geologic processes and geologic history. Interpretation of geologic maps and data relating to earthquakes and plate tectonics. Course will consist of local field excursions and laboratory exercises.

Pre- or Co-Requisite: ENVR-205C

Terms Typically Offered: Fall.



**ENVR-305 Intro to Soil Sciences 3 Credits**

Quantitative study of the chemistry of the solid, liquid, and gas phases in soils and sediments. Topics include solid and solution speciation, mineral solubility, ion exchange and adsorption reactions, oxidation-reduction, and the chemistry of organic contaminants and toxic trace elements in soil. Lecture, 3 hours.

Prerequisite: CHEM-121 and ENVR-150C

Terms Typically Offered: Spring, even years.

**ENVR-305L Intro to Soil Sciences Lab 1 Credit**

Pre- or Co-Requisite: ENVR-305

Terms Typically Offered: Spring, even years.

**ENVR-320 Hydrology 3 Credits**

Introduction to the scientific study of the hydrologic cycle. Covers the measurement and evaluation of hydrologic phenomena including the use of statistical methods. Explores computer techniques in hydrology with applications to water resource development and water quality problems, particularly those in California. Lecture, 3 hours.

Prerequisite: CHEM-121 and ENVR-150C; or permission of instructor

Terms Typically Offered: Spring, odd years.

**ENVR-335 Intro to Atmospheric Sciences 3 Credits**

Covers the structure of the atmosphere and man's impact upon it, especially the causes and consequences of air pollution. Addresses air quality standards and the stratospheric and tropospheric ozone. Also introduces the chemistry of air pollution and air pollution control strategies. Lecture, 3 hours.

Prerequisite: CHEM-121 and ENVR-150C; or permission of instructor

Terms Typically Offered: Fall, even years.

**ENVR-405 Intro to Geo Info System (GIS) 3 Credits**

In this introductory course, students become familiar with the hardware and software components of a Geographic Information System and review GIS applications. Topics include data structures and basic functions, methods of data capture and sources of data, and the nature and characteristics of spatial data and objects. Topics covered include the fundamentals of data structures, georeferencing, data classification, querying, cartography, and basic spatial data analysis. The course provides an overview of the capabilities of GIS software and applications of GIS. Class time is divided between lectures and GIS exercises that reinforce critical concepts. Students must complete a term project as part of the course and should appreciate the utility of Geographic Information Systems in decision-making. Lecture, 3 hours.

Prerequisite: ENVR-150C; or permission of instructor

Terms Typically Offered: Fall, odd years.

**ENVR-430 Environmental Policy and Impact Analysis 3 Credits**

Explores the principles and theories of analyzing environmental interactions. Provides a critical analysis of methodologies for assessing the physical, biological, and social impacts on the environment by human activities. Synthesizes the subject matter through preparation of an environmental impact report. Lecture, 3 hours.

Terms Typically Offered: Spring, odd years.

**ENVR-450 Ug Research Or Internship Program 1-4 Credits**

This course may be taken for a maximum of 4 units in one semester. A maximum of 6 combined units credit for ENVR-450 or ENVR-485 apply to graduation. This course is designed with the purpose of providing students the opportunity to conduct research off-campus at universities or STEM companies in the community. This course promotes early entry into the workplace for the student through part-time employment. This course requires actual work experience be sought in a biotech or STEM-focused business firm providing an opportunity to integrate classroom teaching in practical application under the direct supervision of the assigned instructor. Students are responsible for completing a project report and presenting their research results in ENVR-499C.

**ENVR-485 Undergraduate Research 1-4 Credits**

Problems in advanced laboratory research with emphasis on research techniques. Research is carried out under the supervision of the instructor with weekly conferences to discuss results and direction. Emphasis will be placed on project management, safety, instrumentation, and research documentation skills. A written proposal and report emphasizing the literature background of the problem and the experimental results are required. The results of the research project will also be presented in an oral format in ENVR-499C. This course is a variable credit course. At least two units are required for all Environmental Sciences Majors.. A minimum of 50 hours of laboratory work is required per unit. May be repeated. Lab fee.

**ENVR-488 Environmental Sciences Senior Project 2 Credits**

An advanced course providing the opportunity for a student to create a novel and independent intellectual work by comparing, contrasting, and synthesizing recent research and his/her cumulative knowledge and understanding in Environmental Sciences. The precise nature, scope and format of the project must be developed and approved under the guidance of the instructor and in collaboration with the student's academic advisor. Senior projects are typically initiated in the Fall. The project results must also be presented in ENVR-499C. Lab fee.

**ENVR-499C Capstone Seminar/Environmental Studies 2 Credits**

This course includes a senior thesis covering an approved research topic, analysis and evaluation of current research in the environmental sciences, and the integration of faith and the sciences. An oral presentation of the senior thesis in a classroom setting is required. In-class presentations by faculty and guests are part of the course. Laboratory research in an on-campus research program or an approved off-campus research program may be required for the senior thesis. This course fulfills the Core Curriculum Capstone requirement for Environmental Science majors.

Terms Typically Offered: Spring.

## Mathematics

**MATH-104 Math for Liberal Arts 3 Credits**

A non-technical course emphasizing the ideas and concepts of mathematics. Algebra, number theory, set theory, geometry, statistics, probability, and analysis of the ideas and methods involved.



**MATH-105 Essential Mathematics 4 Credits**

This course prepares students to understand the essential mathematical concepts in number sense, elementary algebra, sets of numbers, problem solving, ratios, proportions, percentages, and graphing linear equations and inequalities. The course is designed to introduce students to practical mathematical skills necessary for courses in business and statistics. Emphasis will be placed on the structural and logical foundations of business. (Meets Elective requirement only; not applicable to Natural Science/Math requirement). (Professional Education course).

**MATH-106 Business Math 3 Credits**

This course applies the principles and practices of mathematics to everyday business problems and situations. The course prepares students to understand the mathematical and business concepts in problem solving, ratios and proportions, percentages, simple and compound interest, graphing linear functions, and inventory valuation. The course introduces students to common mathematical skills necessary for courses in business. (Meets Natural Science/Math requirement). (Professional Education Course).

**MATH-109 Mathematics for Statistics 4 Credits**

This course prepares students to understand the mathematical and statistical concepts in problem solving, critical thinking, ratios and proportions, algebraic equations, sets and logic, probability and statistics, including frequency of distribution, statistical graphs, measures of central tendency, and measure of position and dispersion. The course introduces students to common mathematical skills necessary for coursework in statistics. (Meets Natural Science/Math requirement). (Professional Education Course).

**MATH-115C Applied Mathematics and Personal Finance 3 Credits**

This course introduces the use of mathematics as a logically thinking and problem-solving tool of practical applications, emphasizing inductive and deductive reasoning, graphs, tables, percentage as it applies to loans, mortgages, credit cards, etc., probability, statistics, and the use and misuse of numbers. Applications include variables, conditionals, and statistical functions. Fulfills the core curriculum requirement in mathematics.

Terms Typically Offered: Fall and Spring.

**MATH-116C College Algebra 3 Credits**

Sets and real numbers, linear equations and inequalities, polynomials, functions, graphing linear and polynomial functions, exponential and logarithmic functions, systems of equations, matrices and determinants, sequences and series. Fulfills the Math CORE requirement.

**MATH-120 Math for Elementary Teachers 3 Credits**

Introductory set theory, problem solving, basic algorithms, elementary number theory, geometry and coordinate geometry. Emphasis will be on the structural and logical foundations of mathematics.

Prerequisite: MATH-115C, MATH-170C, or MATH-180C

Terms Typically Offered: Fall and Spring.

**MATH-121 Teaching Math Concepts for K-8 Educators 3 Credits**

This undergraduate course equips future educators with the essential skills to impart mathematical concepts effectively to elementary and middle school students. Participants will delve into innovative teaching methods and strategies tailored to the diverse learning needs of K-8 students, fostering a deep understanding of foundational mathematical principles. Through hands-on activities and collaborative projects, students will gain practical experience in designing engaging lesson plans that promote critical thinking and problem-solving skills. The course emphasizes the use of technology and manipulatives to enhance mathematical learning experiences, preparing educators to create dynamic and interactive classroom environments. By the end of the course, participants will have the knowledge and confidence to inspire a love for mathematics in their students, laying the groundwork for future academic success.

Prerequisite: MATH-115C, MATH-170C, or MATH-180C

Terms Typically Offered: Fall, Spring, and Summer.

**MATH-170C Precalculus 3 Credits**

Equations and inequalities; systems of linear equations: functions, graphs, exponential, logarithmic, and trigonometric functions and their limits; polynomial and rational functions; analytic geometry. Fulfills the core curriculum requirement in mathematics.

Terms Typically Offered: Fall and Spring.

**MATH-180C Calculus I 4 Credits**

Graphing of functions, logarithmic functions and their inverses; limit of functions and derivatives; rules of differentiation and their application; definite and indefinite integrals. Fulfills the core curriculum requirement in mathematics.

Prerequisite: MATH-170C or Permission of Instructor

Terms Typically Offered: Fall and Spring.

**MATH-181C Calculus II 4 Credits**

Application of integration for volumes, work and areas; advanced techniques of integration; advanced application of integration; first order differential equations; parametric equations and polar coordinates; infinite sequences and series.

Prerequisite: MATH-180C

Terms Typically Offered: Fall and Spring.

**MATH-235 Statistics for Health Professionals 3 Credits**

Limited to those enrolled in Health Sciences. Meets statistics prerequisite for NURS 405. This course introduces the conceptual background of statistical techniques and reasoning with an emphasis on application relevant to identifying outcomes. Provides a framework for understanding and applying commonly used data analysis techniques in health science research. Includes selecting, applying, and interpreting univariate and bivariate statistical methods in answering research questions from a health science perspective. (Professional Education Course).



**MATH-265C Intro to Statistical Methods 3 Credits**

This course is cross listed with PSYC-265C and SOC-265C. A course in basic statistical concepts and methods of collecting, summarizing, presenting, and interpreting data in the behavioral sciences; including descriptive statistics (use of graphs and charts), normal distribution curve, measures of central tendency, deviation and dispersion, hypothesis testing, statistical fallacies, correlation, and topics in probability. Students majoring in Accounting, Anthropology, Psychology, or Sociology must take MATH-265C, PSYC-265C, or SOC-265C to fulfill the core curriculum requirement in mathematics. Fulfills the core curriculum requirement in mathematics for students majoring in Accounting, Anthropology, Psychology, or Sociology.

Terms Typically Offered: Fall and Spring.

**MATH-270C Health Professions Statistical Methods 3 Credits**

Meets statistics pre-requisite for NURS-405. The focus of this course is on exploring the statistical methods used in health professions. Students review parametric and nonparametric techniques and explore the purpose, assumptions, selection, and interpretation of descriptive and inferential statistics. As part of the course, students use Microsoft Excel to organize and analyze data sets. Open to all undergraduate health science students.

Terms Typically Offered: Fall and Spring.

**MATH-281 Multivariable Calculus 4 Credits**

Vectors and geometry of space including cylindrical and spherical coordinates; vector functions and space curves with vector calculus, partial derivatives with directional derivatives and applications; multiple integrals with various coordinate systems with application.

Prerequisite: MATH-181C

**MATH-285 Introduction to Advanced Mathematics 3 Credits**

A course for both mathematics and mathematics education majors. Covers the fundamentals of axiomatic proof theory including laws of inference, set theory, induction, cardinality, relations and functions.

Prerequisite: MATH-180C

Terms Typically Offered: Spring.

**MATH-293 Special Topic: 3 Credits**

Study of a special topic in mathematics. May be repeated for credit.

**MATH-294 Sp Top: Into to Comp Science 4 Credits**

Study of a special topic in mathematics. May be repeated for credit.

**MATH-300 Linear Algebra 3 Credits**

Systems of linear equations, vector spaces, linear mappings, matrices and matrix algebra, eigenvectors and eigenvalues, Cayley-Hamilton theorem, quadratic forms, and applications.

Prerequisite: MATH-285

Terms Typically Offered: Fall.

**MATH-310 Differential Equations 3 Credits**

Methods of solution of ordinary differential equations and applications.

Prerequisite: MATH-281, MATH-300

Terms Typically Offered: Spring.

**MATH-315 Teaching/Tutoring 3 Credits**

Students seeking to complete the Single Subject Matter Program in English must take this course as part of that program to ensure they are integrating literary content with their pedagogical experience. This course provides the philosophical background and classroom experience necessary to introduce the student to the teaching profession in a public or private school in a multicultural environment. The purpose of the class is to assist the student in gaining an understanding of the resources and challenges facing a teacher serving a linguistically and culturally diverse student population. Discussion focuses on the major professional organizations and educational research related to the philosophical, historical, and demographic developments of American education. Students complete a 30-hour field work component to observe classroom management and organization, Specially Designed Academic Instruction Delivered in English (SDAIE) instructional practices, and the curricula of grades K-12. The role and function of Christian beliefs and values in the public school are integrated throughout the course. This course is a prerequisite requirement for Multiple and Single Subject Credential programs. Lab fee.

**MATH-330 Number Theory 3 Credits**

Divisibility properties of integers, prime numbers, the Euclidean algorithm, the unique factorization theorem, congruences, Fermat's theorem, Wilson's theorem, Diophantine equations, number-theoretic functions, and the quadratic reciprocity theorem.

Prerequisite: MATH-285

Terms Typically Offered: Spring, even years.

**MATH-365 Probability and Statistics 3 Credits**

Frequency interpretation of probability, axioms of probability theory, discrete probability and combinatorics, random variables, distribution and density functions, sampling theory and limit theorems.

Prerequisite: MATH-281, MATH-285

**MATH-370 History of Mathematics 3 Credits**

An introduction to the history of mathematics from ancient times to the twentieth century, with applications to elementary mathematics through calculus.

Prerequisite: MATH-180C

Terms Typically Offered: Fall, even years.

**MATH-375 Discrete Mathematics 3 Credits**

This course is designed to study graph theory including networks, voting systems including game theory and fair apportionment, and patterns.

Prerequisite: MATH-181C, MATH-285

Terms Typically Offered: Fall, odd years.

**MATH-380 Elementary Analysis I 3 Credits**

Rigorous analysis of the calculus and its foundations. Continuous and differentiable functions, and topological properties of the real number line.

Prerequisite: MATH-281, MATH-285

Terms Typically Offered: Spring, even years.

**MATH-390 Numerical Analysis 3 Credits**

Numerical solution of algebraic equations. Approximate numerical solutions of systems of linear and nonlinear equations, interpolation theory, numerical differentiation and integration, and numerical solution of ordinary differential equations.

Prerequisite: ENGR-307 and MATH-181C

Terms Typically Offered: Spring, even years.



**MATH-400 Casualty & Actuarial Mathematics 3 Credits**

The course covers concepts from calculus and probability as they pertain to actuarial sciences. The calculus part covers limits of functions, derivative and integration and their applications, power series and polar coordinates, multivariate differentiation and integration. The probability part covers basic concepts of probability, conditional probability and Bayes' theorem, discrete and continuous random variables and distributions, bivariate distributions, conditional expectation and variance, transformations of random variables and moment generating function. The pace will be fast and the stress will be on the SOA/CAS Course 1 exam-type of word problems.

Prerequisite: MATH-281 and MATH-365

Terms Typically Offered: Spring, even years.

**MATH-410 Abstract Algebra 3 Credits**

Recommended MATH-310 and MATH-330. Group theory centered on group isomorphisms and homomorphisms. Symmetry, Burnside's Lemma, Group Actions, and the Sylow Theorems. Lattices and Boolean algebras. An introduction to rings and fields, especially polynomial rings, splitting fields, and extension fields.

Prerequisite: MATH-285, MATH-310

Terms Typically Offered: Fall, even years.

**MATH-420 Higher Geometry 3 Credits**

Euclidean geometry from an advanced standpoint, and topics in non-Euclidean geometry.

Prerequisite: MATH-285

Terms Typically Offered: Spring, odd years.

**MATH-450 UG Research and Internship Program 1-4 Credits**

This course may be taken for a maximum of four (4) units in one semester. A maximum of six (6) combined unit credits for MATH-450, DSCI-450, CSCI 450, DSCI-485 and CSCI-485 apply to graduation. This course is designed with the purpose of providing students the opportunity to apprentice with actuarial companies in the community. This course promotes early entry into the workplace for the student through part-time employment. This course requires actual work experience be sought in an appropriate business firm providing an opportunity to integrate classroom teaching in practical application under the direct supervision of the assigned instructor. Students are responsible for completing a project report and presenting their work experience in MATH-499C."

Terms Typically Offered: On Demand.

**MATH-455 Mathematics Teaching Internship 1-3 Credits**

Must have the consent of the instructor and department chair. Regular hours each week for classes and/or meetings are established at the beginning of the semester with the supervising instructor. The intern assists an instructor in planning and conducting a course and/or laboratory session. This course may be taken for 1-3 units per semester. May be repeated for a maximum of six units.

Terms Typically Offered: Fall and Spring.

**MATH-485 Undergraduate Mathematics Research 2 Credits**

This course provides the student with a research experience in mathematics. Emphasis will be placed on project management, professional proofs, computer-aided mathematical exploration, and research documentation skills. This course is a variable credit course. Two units are recommended for all mathematics majors intending to attend graduate school. It is expected that a research report be completed at the conclusion of the research project and an oral presentation of the results be given in MATH-499C. This course may be repeated for credit."

Prerequisite: MATH-285

Terms Typically Offered: Summer.

**MATH-488 Senior Project 2 Credits**

An advanced course providing the opportunity for a student to create a novel and independent intellectual work by comparing, contrasting and synthesizing recent research and his/her cumulative knowledge and understanding in mathematics. The precise nature, scope and format of the project must be developed and approved under the guidance of the instructor and in collaboration with the student's academic advisor. Senior projects are typically initiated in the Fall. The project results must also be presented in MATH-499C

Prerequisite: MATH-285

Terms Typically Offered: Fall.

**MATH-499C Mathematics Capstone 2 Credits**

This course includes analysis and evaluation of current research in mathematics and the integration of faith and learning in mathematics. An oral presentation of research from MATH 485 or 488 is required. In-class presentations by faculty and guests are a part of the course. This course fulfills the Core Curriculum Capstone requirement for Mathematics majors

Terms Typically Offered: Spring.

## Physical Sciences

**PSCI-130C General Physics I 3 Credits**

This is a trigonometry based course in mechanics and heat. Topics include kinematics, Newton's Laws, rotational motion, fluid mechanics, and laws of thermodynamics. A knowledge of algebra, trigonometry, and vectors is necessary for success in this class. Should students not be prepared to succeed in general physics I, it is recommended that students complete MATH-170C or MATH-180C before taking general physics I. Three hours of lecture. This course fulfills the core curriculum lecture requirement in natural sciences.

Co-Requisite: PSCI-130CL

Terms Typically Offered: Fall.

**PSCI-130CL General Physics I Lab 1 Credit**

Laboratory experiments will demonstrate principles studied during lecture sessions. These experiments demonstrate principles in the areas of rotational motion, momentum, fluid mechanics, heat transfer, friction and conservation of mechanical energy. A knowledge of algebra, trigonometry, and vectors is necessary for success in this class. Should students not be prepared to succeed in general physics I lab, it is recommended that students complete MATH-170C or MATH-180C before taking general physics I lab. This course fulfills the core curriculum laboratory requirement in the natural sciences. Laboratory three hours. Lab fee.

Co-Requisite: PSCI-130C



**PSCI-131 General Physics II 3 Credits**

This is a trigonometry based course in electricity, magnetism, sound and light. Topics include mechanical waves, sound, Coulomb's Law, electrostatics, electric circuits, introductory electronics, magnetic fields, induction, wave mechanics, geometrical optics, interference, diffraction and polarization. Three hours of lecture. This course fulfills the core curriculum lecture requirement in natural science.

Prerequisite: PSCI-130C

Co-Requisite: PSCI-131L

Terms Typically Offered: Spring.

**PSCI-131L General Physics II Lab 1 Credit**

Laboratory experiments will demonstrate principles studied during lecture sessions. These experiments demonstrate principles in the areas of electrical current, electrical potential, electrical circuits, magnetic fields, optics, wave motion, and optics. This course fulfills the core curriculum laboratory requirement in the natural sciences. Laboratory three hours. Lab fee.

Prerequisite: PSCI-130CL

Co-Requisite: PSCI-131

Terms Typically Offered: Spring.

**PSCI-215 Fundamentals of Earth Science 4 Credits**

Earth science including physical and historical geology, meteorology, and descriptive astronomy; the economic, social, and philosophical aspects of the subject matter. Lab fee. (meets Natural Science/Math requirement). (Professional Education Course).

Terms Typically Offered: Fall.

**PSCI-215C Fundamentals of Earth Science 3 Credits**

Earth Science including physical and historical geology, oceanography, and descriptive astronomy; economic, social, and philosophical aspects of the subject matter. A three-day field trip is required. This course is recommended for Liberal Studies majors. Lecture three hours each week. This course fulfills the core curriculum lecture requirement in the natural sciences. Fee for the field trip for those not concurrently enrolled in PSCI 215-CL.

Terms Typically Offered: Fall.

**PSCI-215CL Fundamentals of Earth Science Lab 1 Credit**

Classification of rocks, visiting various geological sites, use of topographic and geological maps, oceanographic sampling and techniques, climactic patterns, meteorological measurements, and the use of an astronomical telescope. This course fulfills the core curriculum laboratory requirement in the natural sciences. Lab and field trip fee

Co-Requisite: PSCI-215C

**PSCI-216 Fundamentals of Physical Science 4 Credits**

This course in physical science presents materials in physics, chemistry, and astronomy that are conceptual in nature with minimal reliance on the quantitative rules of mathematics as a tool for understanding. A strong emphasis is placed on proper use of vocabulary words to understand and explain topics in the fields of mechanics, properties of matter, heat, sound, electricity and magnetism, and light. Classroom demonstrations and videos are used to assist the student in learning the everyday principles of nature. Lab fee. (meets Natural Science/Math requirement) (Professional Education Course)

**PSCI-216C Fundamentals of Physical Science 3 Credits**

This course in physical science considers topics in physics, chemistry, and astronomy that are conceptual in nature with minimal reliance on the quantitative rules of mathematics as a tool for understanding. A strong emphasis is placed on proper use of vocabulary words to understand and explain topics in the fields of mechanics, properties of matter, heat, sound, electricity and magnetism, and light. This course fulfills the core curriculum lecture requirement in the natural sciences. Lecture three hours per week.

Co-Requisite: PSCI-216CL

Terms Typically Offered: Spring.

**PSCI-216CL Fundamentals of Physical Science Lab 1 Credit**

An introduction to laboratory practice and procedure in physical science and exercises in mechanics, properties of matter, heat, sound electricity, magnetism, and light. This course fulfills the core curriculum laboratory requirement in the natural sciences. Laboratory Fee.

Co-Requisite: PSCI-216C

Terms Typically Offered: Spring.

**PSCI-223C Mechanics of Solids and Fluids 3 Credits**

This calculus-based course is designed for students with majors in the engineering and physical sciences. The course focuses on the mechanics of solid and fluids. Topics include statics, equilibrium of rigid bodies, free-body diagrams, pericle and rigid body kinematics, li near and angular motion, impluse and momentum, static and dynamic friction, elasticity, fluid properties, laminar and turbulent flow and fluid statics.

Prerequisite: MATH-180C

Co-Requisite: PSCI-223CL or PSCI-223CR

Terms Typically Offered: Fall.

**PSCI-223CL Mechanics of Solids and Fluids Lab 1 Credit**

Laboratory will include experiments in the areas of statics and dynamics of particles and ridgid bodies in two and three dimensions, static and dynamic friction, linear and angular momentum, fluid properties, laminar and turbulent flow and fluid statics. Laboratory three hours. Lab fee.

Prerequisite: MATH-180C

Co-Requisite: PSCI-223C

Terms Typically Offered: Fall.

**PSCI-225 Electricity and Magnetism 3 Credits**

This calculus-based course is designed for students with majors in the engineering and physical sciences. This course focuses on the mathematical and physical description of electrostatics, electric field and potential, electrical fundamentals (charge, current, voltage, resistance, power, energy), DC circuit analysis with Ohm's Law and Kirchoff's Law, AC circuit analysis with phase diagrams, measuring devices (e.g., voltmeter, ammeter), capacitance, magnetic fields and their effect on moving charges and currents, magnetic fields produced by various current configurations, induced emf, mutual and self-inductance, basic theory of dielectrics, magnetic properties of materials and Maxwell's Equations in integral and differential form.

Prerequisite: PSCI-223C

Co-Requisite: PSCI-225L

Terms Typically Offered: Spring.



**PSCI-225L Electricity and Magnetism Lab 1 Credit**

Laboratory will include experiments in the areas of electrostatics, DC and AC circuits, magnetic fields, and electromagnetic induction. Laboratory three hours. Lab fee.

Pre- or Co-Requisite: PSCI-225

Terms Typically Offered: Spring.

**PSCI-227 Waves, Optics and Modern Physics 3 Credits**

This course is designed for students with majors in the engineering and physical sciences. Topics covered include geometric and physical optics, waves and the interaction of light and matter, introductory quantum mechanics, solid state physics, nuclear physics and special relativity.

Prerequisite: PSCI-223, MATH-181

Co-Requisite: PSCI-227L

Terms Typically Offered: Spring, even years.

**PSCI-227L Waves, Optics, and Modern Physics Lab 1 Credit**

Laboratory will include experiments in the areas of mechanical wave motion, sound, interference, geometrical optics, interference, diffraction and polarization of light, radioactivity and the photoelectric effect.

Laboratory three hours. Lab fee.

Pre- or Co-Requisite: PSCI-227

