



## **PRE-ENGINEERING MINOR**

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The Pre-Engineering minor at Westminster is designed for students who wish to combine a liberal arts education with a career in engineering. A student completing the Pre-Engineering minor will earn credit for the courses necessary to complete the dual engineering program with Washington University in St. Louis, Missouri University of Science and Technology, or Southern Illinois University at Carbondale.

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

- [Biology Course Descriptions](#)
- [Chemistry Course Descriptions](#)
- [Computer Science Course Descriptions](#)
- [Engineering Course Descriptions](#)
- [Physics Course Descriptions](#)
- [Mathematics Course Descriptions](#)

Student's Last Name

First Name

Middle Initial

Advisor

Date Minor Declared

Course #	Title of Course	Hours Required	Semester Completed	Grade
<b>Required Courses</b>				
EGR/PHY 101	Introduction to Engineering & Design	3		
CHM 114/115	General Chemistry I	4		
MAT 312	Differential Equations*	3		
PHY 212	Physics II	4		
	A capstone course at the engineering institution taken the last semester before graduation or an approved project in the form of an Independent Study course at Westminster College	1-3		
<b>Electives (choose two)</b>				
BIO 301	Genetics	4		
CHM 124/125	General Chemistry II	4		
EGR/PHY 230	Engineering Mechanics-Statics	3		
MAT 215	Linear Algebra	3		
MAT 313	Mathematical Probability & Statistics	3		
PHY 328	Analogue Circuits	4		
	<b>TOTAL HOURS FOR MINOR</b>	<b>21-25 hrs</b>		

*\*The prerequisites for MAT 312 are MAT 224, MAT 215, and CSC 104 all of which must be completed with a grade of C- or better before enrolling in MAT 312.*

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

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## **BIO – Biology**

**BIO 114 Biological Processes** (3 hrs.). An introduction for the beginning student to fundamental organism and cellular processes such as molecular and Mendelian genetics and photosynthesis. Students must take this course in conjunction with BIO 115. This course is typically offered once per academic year in the fall semester. BIO 114/115 will satisfy the Scientific Inquiry (lab) Context in Tier II of New Foundations and the Natural Science Inquiry Theme of Breakthrough general education programs.

**BIO 115 Biological Processes Laboratory** (1 hr.). Students conduct laboratory exercises selected to reinforce and augment lecture topics in BIO 114. Students are involved in setting up and management of experiments and in analysis of collected data. Students must take this course in conjunction with BIO 114. This course is typically offered once per academic year in the fall semester. BIO 114/115 will satisfy the Scientific Inquiry (lab) Context in Tier II of New Foundations and the Natural Science Inquiry Theme of Breakthrough general education programs.

**BIO 124 Biodiversity** (3 hrs.). This course acquaints students with the major subdivisions of the living world. Anatomical, morphological and life cycle characteristics of representatives of the various phyla and classes are introduced and phyletic and functional interrelationships are stressed wherever feasible. Students must take this course in conjunction with BIO 125. This course is typically offered once per academic year in the spring semester. BIO 124/125 will satisfy the Scientific Inquiry (lab) Context in Tier II of New Foundations and the Natural Science Inquiry Theme of Breakthrough general education programs.

**BIO 125 Biodiversity Laboratory** (1 hr.) This is a survey laboratory and is intended to demonstrate the changes in complexity of form and structure in both plants and animals as evolutionary processes have shaped organisms through geological time. Students must take this course in conjunction with BIO 124. This course is typically offered once per academic year in the spring semester. BIO 124/125 will satisfy the Scientific Inquiry (lab) Context in Tier II of New Foundations and the Natural Science Inquiry Theme of Breakthrough general education programs.

**BIO 204 Animal Behavior** (4 hrs.) This course will introduce students to the field of animal behavior focusing on an evolutionary approach. We will examine both proximate and ultimate causes for why animals behave as they do. Topics range from how neural mechanisms control behavior to why different types of mating systems have developed. This course focuses on how scientists study these areas. Students design and conduct experiments in animal behavior as part of the learning process. This course is typically offered every other academic year. Prerequisites: BIO 124/125 (or BIO 100 General Biology I) and BIO 114/115.

**BIO 205 Ecology and Field Biology** (4 hrs.) This course is designed to familiarize the student with the concepts and principles of ecology as a science. A wide variety of organisms and groups of organisms are studied in relation to various environmental conditions. Short local field trips are used to acquaint students with collecting, census, and ecological measurement techniques and devices. This course is typically offered every academic year in the fall semester. Prerequisites: BIO 124/125 (or BIO 100 General Biology I) and BIO 114/115.

**BIO 206 Laboratory Instruction Techniques** (1 hr.) This course is open to students who are qualified to serve as laboratory assistants in various biology courses. Students assist instructor in the laboratory and serve as mentors for students in course. This course is typically offered every semester during the academic year. Prerequisites: open by invitation to students who have earned an A or B average in NSC 108, BIO 124/125 (or BIO 100 General Biology I), or BIO 114/115.

**BIO 208 Functional Plant Morphology** (4 hrs.) This course is designed as an integrated study of the gross morphology, internal anatomy and physiology of vascular plants. Laboratory studies emphasize the interrelationships between plant form and function. This course is typically offered every other academic year in the spring semester. Prerequisites: BIO 124/125 (or BIO 100 General Biology I) and BIO 114/115.

**BIO 210 Biogeography** (3 hrs.) Biogeography is the study of the distribution of biodiversity over space and time. It aims to reveal where organisms live and at what abundance. It addresses the questions of which species, where and why (or why not). Biodiversity is viewed in light of historical factors, such as speciation and extinction, plate tectonics and glaciations, as well as in the light of current and future threats, including but not limited to climate change. This course is typically offered every other academic year. Prerequisites: BIO 124/125 and 114/115 for Biology and Environmental Science majors; NSC 108 and ENV 105 for non-majors.

**BIO 212 Research Methods in Biology and Environmental Sciences** (3 hrs.) Research methods will introduce you to tools and techniques used in the scientific research laboratory by offering a hands-on research experience allowing data collection, storage, and analysis. Topics include an examination of research types, design, and methodology, scientific communication, and data analysis. Prerequisites: BIO 114/115 and BIO 124/125 or CHM 114/115 and CHM 124/125. MAT 114 is recommended.

**BIO 301 Genetics** (4 hrs.) This course will be an introduction to and a survey of the science of genetics. Topics covered will include classical “Mendelian” genetics, population genetics, and modern molecular genetics. The laboratory will augment these approaches with traditional studies in fly genetics and current practices in molecular genetics. This course is typically offered once per academic year. Prerequisites: BIO 124/125 (or BIO 100 General Biology I) and BIO 114/115.

**BIO 302 Human Anatomy** (4 hrs.) This class is designed for students who are preparing for careers in health-related clinical or research professions or have a deep interest in understanding how the human body works. You will learn about the human form at the gross anatomical level delivered as a regional approach typical of professional schools. In the laboratory, we will be using anatomical models, skeletons, radiographs, and dissection to enhance your understanding of anatomy. This course will challenge you to apply this information to real world clinical and pathological problems. This course is typically offered every academic year in the fall semester. Prerequisites: BIO 124/125 (or BIO 100 General Biology I) and BIO 114/115.

**BIO 303 Microbiology** (4 hrs.) This course serves as an introduction to the structure, physiology, pathogenicity and ecology of microorganisms, particularly the bacteria and viruses. Laboratory work involves effective use of the microscope, staining procedures, handling of pure cultures, analysis of bacterial physiology and identification of unknown bacteria. This course is typically offered once each academic year in the fall semester. Prerequisites: BIO 124/125 (or BIO 100 General Biology I), BIO 114/115.

**BIO 310 Environmental Toxicology** (3 hrs.) In this course, you will be introduced to the field of environmental toxicology from a biological perspective. We will discuss uptake of chemicals from the environment, biotransformation, and toxicity. We will examine a wide array of endpoints from cellular biomarkers to population-level effects in invertebrates and vertebrates, including humans. Prerequisites: BIO 124/125 and BIO 114/115

**BIO 314 Vertebrate Histology** (2-4 hrs.) The aim of this course is to introduce students to the microscopic anatomy and histophysiology of vertebrates. Particular emphasis will be placed on the interrelation between structure and function. In addition, this course will teach students to become proficient in using the microscope to interpret fine structure. This course is typically offered as independent study. Prerequisite: BIO 124/125 (or BIO 100 General Biology I) and BIO 114/115.

**BIO 315 Entomology** (4 hrs.) This course focuses on the biology of insects with the following three objectives: (1) An introduction to common methods used in the field of entomology. (2) The ability to identify many common insect orders and families, since it is impossible to understand something if you do not know what it is. Finally, (3) an introduction to the evolution, behavior, and ecology of this fascinating group. This course is typically offered every other academic year in the fall semester. Prerequisites: BIO 124/125 (or BIO 100 General Biology I) and BIO 114/115.

**BIO 318 Ornithology** (4 hrs.) Ornithology is the study of avian biology (birds). The broad goals of this course will be to (1) introduce you to the evolution, behavior, and ecology of birds; and (2) provide you with the ability to identify many common bird species in the wild by sight, sound, behavior, and habitat. This course meets twice a week in a lecture/laboratory class setting. Several trips will be taken into the field to identify birds. Please note that on rare occasions, the class period may run 10-20 minutes longer to accommodate longer trips afield. This course typically is offered every other academic year in the spring semester. Prerequisites: BIO 124/125 (or BIO 100 General Biology I) and BIO 114/115.

**BIO 320 & 321: Biology in Belize** (4 hrs.) This course serves as an introduction to the natural history, geography, pre- and post-Columbian history, land-use patterns, and current political climate of Belize, Central America. Following a preparatory spring semester seminar (BIO 320), a three-week Summer Session course (BIO 321) will be taught in Belize where students will study the biota of the offshore caves, coral reefs, grassland savannas and neo-tropical jungles. Special attention will be paid to local land use and conservation issues and the effects of ecotourism on the local economy and relevant ecosystems. Prerequisites: Completion of at least two courses in biology or permission of the instructor.

**BIO 322 Vertebrate Biology** (4 hrs.) Vertebrate Biology takes a comparative approach to the study of the diversity of vertebrate life both extinct and extant. Anatomy, ecology, behavior, and evolutionary history will all be discussed as part of a broad introduction to the vertebrates. The dissection of representative species of the major vertebrate groups is the focus of the weekly laboratory. This course is typically offered every other academic year. Prerequisites: BIO 124/125 (or BIO 100 General Biology I) and BIO 114/115.

**BIO 325 Molecular Cell Biology** (4 hrs.) This course is a study of eukaryotic cells at the molecular level. Topics include protein biosynthesis and trafficking, membrane structure and function, cellular, subcellular, and extracellular structure, and the cell cycle. The course correlates the cellular structures to their function within the cell. The laboratory is designed to complement these topics, with an emphasis on student self-design. This course is typically offered once every one-two academic years. Prerequisites: BIO 124/125 (or BIO 100 General Biology I) and BIO 114/115. BIO 301 Recommended.

**BIO 328 Insects and Human Affairs** (3 hrs.) This course provides an introduction to insects and their interactions with humans. Human beings and insects will be compared with respect to both form and function, and students will learn to distinguish the major groups of insects. The course will examine the effects of insects on agriculture (both harmful and helpful), the impact of insects on the course of human history, and their representation in art, music, and literature. This course is typically offered every other academic year in the spring semester. BIO 328 will satisfy the Scientific Inquiry (non-lab) Context in Tier II of the General Education Program and the STEM and Society Explorative Cluster of Breakthrough general education program.

**BIO 330 Virology** (3 hrs.) This course will introduce students to the basic biology of viruses and then look at some contemporary issues that involve viruses. Topics covered will include the cellular and molecular mechanisms of virus reproduction including virus structure, virus-cell interactions, virus infection, oncogenes, and viral transformation of cells to cancer. We will also consider the evolution and ecology of viruses and the epidemiology of viral infections. Examples will be taken from bacterial, plant, and animal viruses, including newly emerging viruses. Contemporary topics will include the AIDS epidemic, emerging pathogens such as West Nile virus, bird flu, or Ebola virus, the renewed threat of smallpox, etc. Portions of the course will include student-led discussions of specialized topics of their choice. Prerequisites: BIO 124/125 (or BIO 100 General Biology I) and BIO 114/115. BIO 301 recommended.

**BIO 335 Medical Terminology** (1 hr.) The course is designed to help students develop a vocabulary for accurately describing the human body and associated components, conditions, processes. This systematic approach to word building and term comprehension is based on the concept of: (1) word roots, (2) prefixes, and (3) suffixes primarily derived from Latin and Greek origins. This course is typically offered every academic year. Prerequisites: BIO 124/125 (or BIO 100 General Biology I), BIO 114/115, and permission of instructor required.

**BIO 372 Developmental Biology** (4 hrs.) How does the fertilized egg transform into an organism? What changes over time lead to the specialized tissues and organs of animals? Developmental Biology is a survey of animal development, from sperm and unfertilized egg through embryonic development. Molecular, cellular, genetic, and organismal topics will be included. This course will complement your studies of genetics, cellular, animal, and human biology as we discuss how genotype becomes phenotype. The laboratory will include descriptive and experimental approaches. Typically offered every other year. Prerequisites: BIO 124/125 (or BIO 100 General Biology I), BIO 114/115 and BIO 301 (Or with permission).

**BIO 398 Independent Research Projects** (1-4 hrs.) Students interested in independent reading or developing individual research projects may enroll in BIO 398 for variable credit. The faculty in the department strongly encourages students majoring in biology to develop and pursue at least one research project. This course is typically offered every semester during the academic year. Prerequisites: BIO 124/125 (or BIO 100 General Biology I) and BIO 114/115, as well as permission of the department chair.

**BIO 404 Biochemistry** (4 hrs.) This course is an advanced survey course for students who expect to continue graduate study in biology or continue on to a professional career in a health-related field. Topics include a detailed study of the structure of biological molecules and the function of enzymes, followed by a survey of basic intermediary metabolism. The laboratory is a project-based laboratory incorporating many of the principles covered in lecture. This course is typically offered once each academic year in the spring semester. Prerequisites: CHM 314, 315, 324, and 325 (CHM 324 & 325 can be taken concurrently with BIO 404), BIO 124/125 (or BIO 100 General Biology I) and BIO 114/115.

**BIO 415 Human Gross Anatomy** (4 hrs.) Students will complete a human dissection, as a team, with a minimum of 6 hours of contact per week. The dissection will be completed as it would in a medical school gross anatomy course, to include a complete regional dissection. Additionally, an assessment of the health of the donor will be completed. The students will be required to share their findings with the community and in other courses as appropriate. This course is typically offered once each academic year in the fall semester. Prerequisites: BIO 124/125 (or BIO 100 General Biology I), BIO 114/115, and BIO 302 (Must have been taken at Westminster). The course is by application and consideration of faculty in the department, and requires instructor permission.

**BIO 420 Physiology** (4 hrs.) This class is designed for students who have a deep interest in understanding how the human body works. Physiological principles and examples will be geared towards humans, but in many instances are also applicable to other vertebrates. You will learn about how the human body functions at molecular, cellular and systems levels. This course will challenge you to apply this information to real world clinical and pathological problems. You will be expected to critically evaluate current scientific literature and discuss recent scientific findings with your fellow classmates. You will learn how to use physiological lab equipment and then conduct an independent research project. This course is typically offered once each academic year in the spring semester. Prerequisites: BIO 114/115, BIO 124/125 (or BIO 100 General Biology I) and BIO 302 or BIO 322 with a grade of C- or better.

**BIO 450 Evolution** (3 hrs.) Evolution is the unifying theory of biology. This course will examine Charles Darwin's theory of evolution by means of natural selection looking at the development of this theory and its modern applications. Topics will include the fundamental mechanisms for evolution, including those that are both adaptive and neutral with respect to the process of adaptation; human evolution; the origin and definition of a species; molecular evolution; the relationship between evolution and religion; and modern challenges, modifications, and support for this far-reaching theory. This course is typically offered every academic year in the fall semester. Prerequisites: BIO 124/125 (or BIO 100 General Biology I) and BIO 114/115, junior or senior status.

## 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.

## **CSA – Computer Systems Analysis**

**CSA 104 Programming Logic and Design** (3 hrs.) This course is an introduction to computer programming logic and design concepts that present the appropriate techniques and tools employed to clearly define and specify the functional requirements of a structured computer program. It promotes sound computer program design through a modular approach emphasizing logical reasoning and critical thinking that will enhance the design of any computer program. Students will test programming logic using a flowchart visualization tool and will explore coding examples from several different low- and high-level programming languages. This course also presents an introduction to the discipline of Systems Analysis and uses the systems development life cycle as a framework in which to introduce topics such as defining user requirements, documentation, software development methodologies, continuous quality management, and system testing strategies. Students will use general purpose software for creating program design documentation and will explore career opportunities in the discipline. It serves as a prerequisite to other programming courses offered through the department. (Previously offered as SEG 104).

**CSA 250 IT Infrastructure** (3 hrs.) The content of this course will present aspects of an organization's IT infrastructure, specifically networking, firewalls, servers, storage options, desktop computing, and mobile devices. Emphasis will be on advantages and disadvantages of different infrastructures and computing and storage options. Cloud computing technologies will be explored as viable options for storage, software, and computing needs of an organization. Information security considerations are included as essential component to any infrastructure decision. Prerequisites: none. Offered every fall.

**CSA 304 Structured Programming** (4 hrs.) This course provides students with experience in properly designing, implementing, and testing structured computer programs implemented in the C++ language using skills developed in CSA 104. The course extends the practice of problem solving, algorithm development, and program documentation forming the foundation for exploring C++ concepts in logic control structures, modular programming, functions, input, output, file processing, user defined data types, static arrays, and user defined function libraries. Programming concepts of code reuse, program interactivity, testing methods, data validation, and user interface design are incorporated throughout the course. Additional topics include proper programming techniques, strategies for debugging, interpreting design documents, and preparing documentation. Prerequisite: CSA 104. Offered every fall semester. (Previously offered as SEG 304).

**CSA 321 Python Programming** (3 hrs.) This course focuses on the essential elements of computer programming design and implementation for constructing applications using the Python programming language. Topics covered include expressions, variables, user-defined functions, logic structures, modules, and file processing. An introduction to Python libraries will include the built-in functions specifically for math, data science, graphics, and user interface applications. Additional topics include proper programming techniques, strategies for debugging, interpreting design documents, and preparing documentation. Interactive, hands-on assignments will provide the student opportunity to design software solutions to authentic problems encountered in a variety of disciplines and careers. Prerequisites: CSC 104. Offered every spring semester. (Previously offered as SEG 321)

**CSA 322 Information Visualization** (3 hr.) Using Excel and Python, students will explore different techniques for representing information for reporting via various media outlets. Additionally, specific Python libraries designed for working with a variety of input file types, file processing, data cleaning, and information visualization will be utilized. Students will have the opportunity to work with data files from a variety of academic disciplines. The ethical collection and use of organizational data will be discussed. This course includes a study of the transformation of organizational data into meaningful information. Students will learn how to use Python and Excel to effectively present information to a variety of audiences in a variety of formats to satisfy a research question or information need. Prerequisites: SEG 104 and SEG 321; or BUS 210. Offered every odd fall semester. (Previously offered as SEG 322)

**CSA 327 Database Systems** (3 hr.) This course will enable the student to translate the information needs of an organization into effective conceptual and logical data models that can be implemented in any relational database system. It utilizes a problem-based approach to learning focusing on teamwork, real-world examples, and in-class exercises allowing the student to immediately apply the knowledge gained. Students will have opportunities to create and manipulate a database from data design documents. Additional topics include dataflow diagrams, database administration, the three-tiered database architecture, data normalization, database transaction management, data security, information assurance, and SQL programming. Prerequisites: CSA 104. Offered every even fall semester. (Previously offered as SEG 327).

**CSA 351 IT Project Management** (3 hr.) This course presents tools and techniques for managing IT systems development projects throughout the systems development life cycle. Topics managing project integration, scope, requirements, schedule, cost, staffing, quality, communications, risk, and procurement. Emphasis is also given to stakeholder management, leading the project team, and project documentation. Students will learn to utilize software tools such as Microsoft Project and Excel to facilitate project management tasks such as cost-benefit analyses, quality metrics, and communications. While the emphasis of this course is on IT systems project management, the concepts are easily transferrable to the management of any type of project. Prerequisites: BUS 220, CSA 104, or ITY 250. (Previously offered as SEG 351)

**CSA 390 Object Oriented Programming** (3 hrs.) This course focuses on the object-oriented programming methodology using the C++ programming language. This methodology is often used for developing large, complex information systems. Topics covered include data abstraction, inheritance, and reusable components. The use of classes and objects is incorporated throughout the object-oriented software development processes of scenario definition, design, building, implementation, and coding. Programming concepts enforced throughout the course specifically emphasize software reliability, testing, and reusability. Additional topics include proper programming techniques, strategies for debugging, interpreting design documents, and preparing documentation. Prerequisites: CSA 104 and CSA 304.

**CSA 404 Data Structures** (4 hrs.) A second course in computer programming in C++ that covers multi-dimensional arrays, dynamic arrays, pointers, user defined data structures, function and operator overloading, records and structs, exception handling, memory management, and various sorting algorithms. This course focuses initially on the basic common data structures (lists, stacks, queues, trees, heaps, graphs) using modular design. Classes and data abstraction are introduced. Careful attention is given to modular architecture that promotes reliability and reusability. Additional topics include proper programming techniques, strategies for debugging, interpreting design documents, and preparing documentation. Prerequisites: CSA 104 and CSA 304. Offered even spring semester. (Previously offered as SEG 404)

**CSA 470 Computer Systems Analysis Capstone I** (3 hrs.) This capstone course is to be taken in the fall semester of the senior year as the first course in a two-course capstone sequence. It would cover the first phases of the systems development life cycle including project estimation and planning, feasibility analysis, cost-benefit analysis, problem analysis, requirements elicitation and definition, solution and engineering design, and quality control planning. The student will engage in a systems development project approved by the instructor to be used to demonstrate concepts presented in the course. The student should select a software development project sufficient in scope to continue through the second capstone course. The project may incorporate programming, web development, media creation, or other type of software as part of the overall project. Additional topics include professional development, career exploration, communications, and technical writing. Prerequisites: CSA 104, CSA 304, or ITY 250, and CSA 351. Offered every fall semester. (Previously offered as SEG 470)

**CSA 480 Computer Systems Analysis Capstone II** (3 hrs.) This capstone course would be taken the spring semester of the senior year as the second course in the two-course capstone sequence. It would cover the final phases of systems development including building, testing, implementation, quality control, and measures of success. The student will engage in a systems development project approved by the instructor and continued from the first capstone course. The project may incorporate programming, web development, media creation, or other type of software as part of the overall system. At the end of this course, the student will have a working prototype of some component of their project, depending on scope and project goals. Heavy emphasis will be placed on quantitative metrics use for cost-benefit analyses, resource management, and quality control. Additional topics include professional development, career readiness, communications, and technical writing. CSA 104, CSA 304, or ITY 250, and CSA 351, CSA 470.

## EGR – Engineering

**EGR/PHY 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.

**EGR/PHY 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 – 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.

## 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.