THE GOVERNOR'S SCHOOL for SCIENCE AND TECHNOLOGY

POS Course Descriptions 2025-2026 SY

Advanced Chemical Analysis (4471/03102): (2 weighted high school science credits) This course focuses on the fundamental principles and laws of chemistry. Extensive laboratory work will serve as the basic tool for students to explore chemistry topics and develop data collection and analysis skills. Insights into inorganic and organic chemistry will be provided. The students will explore advanced concepts such as kinetics, acid/base chemistry, equilibrium, thermochemistry, nuclear chemistry and electrochemistry. The course will emphasize problem solving through chemical calculations. Advanced Chemical Analysis is a college-level course with a strong focus on laboratory work. It examines topics typically studied during the first year of college by science majors. *Prerequisite: Chemistry; Biology; Algebra II/Trig.*

Advanced Biological Analysis (4371/03052): *(2 weighted high school science credits)*
In the fall semester, the course will cover topics in cell and molecular biology, addressing the roles of biological macromolecules, cellular organization, metabolism, and processes such as cellular communication, genetics, respiration, and photosynthesis. The spring semester will focus on gene expression and control, evolution, and the diversity of living things. A significant component of the course is the laboratory experience, providing students with hands-on opportunities to apply technologies used in research, medical, and forensic laboratories. Students will design many of their experiments and will analyze and interpret results. Laboratory activities encompass biochemical, molecular, and cellular techniques, including spectrophotometry, analysis of gas products of respiration, fermentation, and photosynthesis, compound light microscopy, PCR, DNA electrophoresis, CRISPR, culture of eukaryotic and prokaryotic organisms, and animal dissection. Advanced Biological Analysis is a college-level course that explores topics typically studied during the first year of college by biology majors. *Prerequisite: Advanced Chemical Analysis.*

Calculus-based Engineering Physics I: (45711/03163): *(2 weighted high school science credits)* This mathematically rigorous course delves into the principles of classical mechanics and thermodynamics, encompassing topics such as kinematics, Newton's laws of motion, work, energy, momentum, rotational kinematics, dynamics and static equilibrium, elasticity, gravitation, fluids, simple harmonic motion, calorimetry, the ideal gas law, and the laws of thermodynamics. It is a calculus-based introductory physics course with a laboratory sequence. The course aims to impart a broad understanding of general concepts and principles in the physical universe. It equips students with essential

skills in problem-solving, critical thinking, and quantitative reasoning, fostering an understanding of scientific inquiry methods and experiments. This first-year course sets the foundation for advanced studies in physical sciences and engineering. *Prerequisite: Biology; Chemistry; Precalculus.*

Calculus-based Engineering Physics II: (45712/03164); (2 *weighted high school science credits)* This two-credit course builds on Physics I and Calculus, integrating advanced physics theory with practical engineering applications. Students study electricity and magnetism, electromagnetic waves, optics, and modern physics, with emphasis on circuits, electromagnetic fields, Maxwell's equations, wave and geometric optics, special relativity, and quantum mechanics. The course emphasizes problem-solving, conceptual mastery, and engineering skills through hands-on activities such as C++ programming, designing electronics and digital systems, and using CAD and additive manufacturing. Semester-long projects allow students to tackle real-world challenges, often collaborating with organizations like NASA and Jefferson Labs. Throughout, students develop critical thinking, teamwork, laboratory skills, and rigorous error analysis, preparing them for advanced study and professional work in applied physics and engineering. *Prerequisites: GSST Physics I; Calculus.*

Computational Physics (Algebra-based): (4525/03165): (2 *weighted high school science credits)* This year-long course introduces students to the fundamental principles of physics through both conceptual understanding and hands-on application. The first semester focuses on classical mechanics and thermodynamics, including motion, Newton's laws, energy, momentum, rotation, gravitation, fluids, oscillations, and the laws of thermodynamics. The second semester builds on this foundation with the study of waves, sound, electricity and magnetism, circuits, optics, and selected topics in modern physics. Emphasizing both lecture and laboratory work, students will apply physics concepts through hands-on experiments and strengthen their problem-solving skills using algebra, computer modeling, and computational tools such as Python, MATLAB, or spreadsheets. By integrating coding and simulations with traditional physics labs, students explore how physics principles connect to real-world systems and modern scientific research. *Prerequisite: Chemistry; Biology; Precalculus.*

Computation Science: Engineering Design, Innovation & Entrepreneurship (4550/03152): *(2 weighted high school science credits).* The EDIE Lab is the culminating experience for seniors in the Engineering and Computational Science Strands, providing an interdisciplinary capstone that merges physics, programming, and engineering design. The course emphasizes the application of foundational physics concepts as the framework for solving authentic engineering and computational challenges.
The EDIE Lab fosters the fusion of mathematics, physics, and programming through collaborative, project-based learning. Students explore advanced programming topics such as object-oriented programming, data structures, and algorithms using C++ and Python, as well as introductory data science applications. Through semester-long keystone projects, students develop critical thinking, teamwork, and laboratory skills,

connecting classroom physics to real-world engineering and computational applications. By integrating coding, simulation, and experimental design, students emerge with the knowledge and skills to pursue advanced study and professional careers in applied physics, engineering, and computer science. *Prerequisites: Computational Physics; Pre-Calculus.*

College Modern Pre-Calculus (3162/02104): *(1 weighted high school math credit)*
This course is an intensive, rigorous approach to mathematics designed to prepare students for college calculus. First semester, students will focus on the algebraic and geometric properties of polynomial, rational, exponential, logarithmic, and trigonometric functions, and engage in discussions about how these models are represented in the real world. Second semester, students will learn the analytic properties of trigonometric functions and geometric conics, as well as learning the properties of polar coordinates, vectors, matrices, parametrics, and sequences and series. *The course concludes with an introduction to calculus. Prerequisites: Algebra II/Trig.*

College Calculus (3177/02121): *(1 weighted high school math credit)*
This two-semester course offers university-level calculus for scientists and engineers, emphasizing comprehension and practical application. In the first semester, topics include limits and continuity of functions, techniques and applications of differentiation, and an introduction to integration. The second semester covers applications and advanced techniques of integration, introduction to differential equations, sequences and series, and analytical geometry. Upon completion, students will grasp both the geometric and rate of change analyses of differential and integral calculus. They will be able to apply their understanding to model real-world situations mathematically and solve these mathematical models. *Prerequisites: Precalculus.*

Multivariable Calculus (3178/02122) / Linear Algebra (3180/02111): (1 weighted high school math credit). In multivariable calculus, students extend their study of calculus from the plane to 3-dimensional space and beyond. After an initial examination of the geometry and algebra of 3-space, students will use differential and integral calculus to study the nature of curves and surfaces in 3-space. Topics include linear approximations of curves and surfaces in 3-space, optimization of functions with several variables, and the use of integral calculus to study area, volume, and other applications. The semester concludes with an examination of the calculus of vector fields. In linear algebra, students use matrix theory to solve systems of linear equations and apply knowledge of determinants to describe the nature of those solutions. The algebra and applications of linear transformations will be studied in both real and general vector spaces. Students will calculate eigenvalues and eigenvectors of linear transformations and use them to diagonalize linear systems. Applications include best-fit functions and solutions of 1st-order linear differential equations. *Prerequisites: GSST College Calculus or completion of AP Calculus BC with a score of 5 on the exam, or a score of 4 with permission from the instructor.*

Differential Equations (3179/02123): *(1 weighted high school math credit).* This year-long course introduces the methods, theory, and applications of differential equations. This course introduces first-order, second-order and higher-order linear differential equations, series solutions, linear systems of first-order differential equations, and the associated matrix theory. *Prerequisite: Calculus.*

Research Methodology & Ethics (4610/03212): *(1 weighted high school elective credit).* This year-long course provides junior STEM students with knowledge and hands-on experiences in conducting scientific research and engineering projects. Participants will delve into contemporary issues in scientific research while independently working on scientific and engineering projects outside of class. Students are encouraged to choose projects aligned with their strand or career goals. Course topics encompass research design strategies, data analysis and representation (with and without computer assistance), ethical norms for research behavior, and the historical foundations of current research regulations, among other relevant subjects. Each student is required to conduct a comprehensive review of the primary literature to support their research design assumptions, prepare and present a plan for their proposed research for institutional review and approval, carry out their studies, and report their findings through a formal technical paper and oral presentation. Active participation in regional science and engineering fairs is highly encouraged.

Honors Research & Mentorship (4612/03201-III): (2 weighted high school elective credits). Students explore advanced topics in scientific research with an emphasis on scientific literature and methods, leading to the preparation of a research proposal in conjunction with their mentorship work. Students will prepare research documents for professional presentations. The mentorship involves students in concentrated research or project development in firms and laboratories throughout the Tidewater region, supervised by mentors who are scientists, engineers, physicians, and other professionals. During the mentorship, students plan, implement, document, and present their chosen research or projects in consultation with their mentors. This process refines their research and presentation techniques, problem-solving abilities, critical thinking, and leadership skills. Proficiency with statistical software, such as Excel, is gained for data presentation and analysis. Moreover, students explore the evolving field of data science at an introductory level, providing a broad overview of its use and application in daily life. They learn to think critically about the ethics of data collection and analysis in research, industry, and government. Programming is integral to the course, focusing on learning how to program in R, a language for statistics and data science. Overall, the course covers introductory statistics, the ethical considerations of data analysis and collection, and programming for data analysis in R. It provides students with an opportunity to integrate theory, knowledge, and application through a comprehensive research experience. *Prerequisite: GSST Research Methodology & Ethics course.*