Subject	Montgomery College Early College Program Pathway General Engineering						
	Grade 9 ***MCPS/MC Credits***	**Grade 10** **(at HS Campus)**	**Summer**	**Grade 11**	**Winter Term Grade 11** **&/or Summer**	**Grade 12**	**Winter Term** **Grades 12**
English	Honors English 9, *1/0*	Honors English 10, *1/0*		Sem 1: ENGL101, *1/3* Sem 2: ENGL102, *1/3*			
Math	Algebra 2, 1/0	Precalculus or high level, *1/0*		Sem 1: MATH 181, *1/4* (MATF) Sem 2: MATH 182, *1/4*		Sem 1: MATH 280, *1/4* Sem 2: MATH 282, 1*/3*	
Science, or Natural Science	9th Grade Science, Biology, *1/0*	10th Grade Science, Chemistry, 1/0		Sem 1: CHEM 131, 1/4, (NSLD) Sem 2: PHYS 161, *1/3,* (NSND), CHEM 132, 1/4*		Sem 1: PHYS 262, 1/4*,* (NSLD) Sem 2: PHYS 263, *1/4,* (NSLD)	
Social Studies, or Humanities/ Electives	US History or NSL, 1/0	US History or NSL*, 1/3*			Sum I: HIST 117, 1/3*(HUMD and GEIR)* Sum II: HLTH 105 (if MCPS heath credit needed)		
Arts, Fine Arts						Sem 2: MUSC 117, *l/3* (ARTD)	
Behavioral and Social Sciences					Winter: PSYC 102, *1/3* (BSSD)		SOCY 100, 1/3 (BSSD)
Physical Education, Health	General P.E., *1/0*	Sem 1: Health .*5/0*					
Program Completer/Track Electives	For. Language, *1/0*	For. Language, *1/0*				Sem 1: ENEE 140*, ENES 102*, *2/5* Sem 2: ENES 221*, *1/3*	
Technology Education	MCPS Tech Course, *1/0*			Sem 1: ENES 100, 1/3*			
Elective/MC classes			Early College Summer Transition Program				

AP/IB Exam scores may qualify students to earn approved college credits replacing a course requirement above. *=Engineering elective

As of 10/10/20

Credits Earned (Number of Courses Taken) per Semester	Grade 09	Grade 10	Grade 11	Grade 12
Sem 1	0	0	14 (4)	13 (4)
Winter			3(1)	3(1)
Sem 2	0	0	14 (4)	13 (4)
Summer	0	0	3-6 (1-2)^	3 (1)

* Optional credits and courses are included in the number of credits earned and courses taken above. Some courses and credits may be earned through Advanced Placement exam equivalencies.

^ Two summer courses if MCPS health requirement unfufilled

Graduation Audit/Advising Worksheet
Early College

GENERAL ENGINEERING† A.S.: 410

Total Credits: 64

Name:	Date:	ID#

GENERAL EDUCATION FOUNDATION & DISTRIBUTION COURSES

FOUNDATION COURSES	Course (Req'd)	HRS	Source of Credit
English 101 (Assessment Levels (AL): U ENGL101, U READ120); (Prerequisites (PR): U None)	ENGL101	3	
English Foundation (AL: U ENGL101, U READ120); (PR: U A grade of C or better in ENGL 101 or ENGL 101A or consent of department)	ENGL102	3	
Math Foundation	MATH181	4	
Health Foundation (HLHF)	HLTH105	1/3	If no MCPS Health credit then HLTH105, otherwise 1 credit health course

DISTRIBUTION COURSES	Course (Req'd)	HRS	Source of Credit
Arts Distribution (ARTD)	MUSC117	3	Or Similar; MCPS Approved if Fine Art Credit needed
Behavioral/Social Sciences Distribution (BSSD) †	PSYC102	3	
Behavioral/Social Sciences Distribution (BSSD) †	BSSD	3	Elective meeting BSSD Requirement
Humanities Distribution (HUMD)	HIST117	3	
Natural Sciences Lab Distribution (NSLD)	CHEM131	4	
Natural Sciences Lab Distribution (NSLD)	PHYS263	4	

Curriculum Requirements	Course (Req'd)	HRS	Source of Credit
Natural Sciences w/out Lab Distribution (NSLD)	PHYS161	3	
	CHEM131	4	
	ENES100	3	
	MATH182	4	
	MATH280	4	
	MATH282	3	
	PHYS262		
EE (Electrical Engineering) or ES (Engineering Science) Elective	ENES102	3	
EE or ES Elective		3	
EE or ES Elective		3	
EE or ES Elective		3	

Multicultural Course: **Total Credits:**

† The two Behavioral/Social Sciences courses MUST be in different disciplines ‡ The two behavioral and social sciences course MUST be in different disciplines

http://cms.montgomerycollege.edu/Curricula/Engineering_Science_A_S_-_General_Engineering/#General

Engineering Science AS Degree, General Engineering Area of Concentration: 401

A general engineering major at the associate's degree level provides solid preparation for any type of engineering degree at the bachelor's level. And if you decide to earn a bachelor's degree in general engineering, you will study many different fields of engineering and business. You could then go on to coordinate teams of engineers, oversee product development from invention to market, or use your engineering know-how in a non-engineering field, such as law or medicine.

Upon completion of this program a student will be able to:

- Identify, formulate, and solve basic physics and engineering problems in the areas they choose their elective coursework
- Make basic designs of systems in their area of choice using analytical and numerical methods
- Use appropriate computer application software in engineering.

Transfer Agreements

Capitol Technology University (MD)

- A.S. Electrical Engineering to B.S. Electrical Engineering

Frostburg State University, Arundel Mills Campus (MD)

- A.S. Engineering Science, Electrical Engineering to B.S. Electrical Engineering

George Washington University, College of Professional Studies (D.C./VA)

- A.A., A.S. or A.A.S. in Biotechnology, Business, Computer Science, Information Systems, Engineering Science or any science or technology related field to Bachelors Degree Completion Program Integrated Information Science & Technology

Georgia Institute of Technology (GA)

- A.S. Engineering Science, General to B.S Engineering

Shepherd University, (WV)

- A.S. Engineering Science, General Engineering to B.S. Computer Engineering

Course Descriptions

CHEM 131 – Principles of Chemistry I

(NSLD, GEEL)
First of two related courses (with CHEM 132). Includes concepts of atomic structure, periodic system, chemical bonding, nomenclature, stoichiometry, weight relationships, kinetic molecular theory, gases, liquids and solids, solutions, chemical reactions, and thermochemistry. PREREQUISITE(S): Either appropriate score on the chemistry placement test, or a grade of C or better in CHEM 099 within the past two years, or consent of department. Assessment Level(s): ELAI 990/ENGL 101/ENGL 101A, MATH 117 or higher, READ 120. Three hours lecture, one hour discussion, three hours laboratory each week. Formerly CH 101.
4 semester hours
May not be taken concurrently with MATH 017 or MATH 020 or MATH 045 without appropriate Math assessment score.
Course Outcomes:
Upon course completion, a student will be able to:

- Perform mathematical operations relevant to chemical problems.
- Describe the electronic structure of atoms, ions, and molecules.
- Analyze chemical problems involving various phases such as gases and solutions.
- Collect, analyze, and report experimental laboratory results.

ENES 100 - Intro to Engineering Design

(NSND, GEEL)
Overview and application of the basic tools and techniques of engineering design and graphic communications, including CAD, engineering reports, cost analysis, and use of software tools. Group projects are assigned. Assessment Level(s): ELAI 990 or ENGL 101/ENGL 101A, MATH 165, READ 120. Two hours lecture, two hours laboratory each week. Formerly ES 100.
3 semester hours
Course Outcomes:
Upon course completion, a student will be able to:

- Describe the engineering design procedures.
- Apply the principles of engineering graphics to create engineering sketches.
- Design and assemble a machine or a structure to perform a specific task in a team effort.
- Apply the basic laws of physics to the design project.
- Translate the design equation into a computer spreadsheet (Excel) and perform a graphic analysis.
- Select the most cost effective design solution which can be completed within the time constraint.
- Demonstrate knowledge of the operation of a parametric computer-aided design system (Pro/Engineer) and use it to create parts. assemblies, and drawings.
- Prepare a design report using a word processor (Word) and present the design project using a presentation tool (PowerPoint).

ENES 102 - Statics

Introduction to statics of particles and rigid bodies, equivalent systems of forces and moments, and equilibrium of rigid bodies. Topics include distributed forces, analysis of trusses, frames and simple machines, friction, centroids, and moment of inertia. PREREQUISITE(S): MATH 181 with a grade of C or better. PRE- or COREQUISITE(S): PHYS 161 Three hours each week. Formerly ES 102.

3 semester hours

Course Outcomes:

Upon course completion, a student will be able to:

- Describe mathematically position, force, and moment vectors in two and three dimensions.
- Reduce a simple distributed loading to a resultant force or wrench at a specified location.
- Draw a free-body diagram of a rigid body and write and solve the equations of the equilibrium.
- Evaluate forces in trusses, frames and simple machines including frictional forces.
- Identify the internal forces in a member of structure and draw shear-moment diagrams of a beam.
- Calculate centers of mass, and moment of inertia for particular structures

ENGL 101 - Introduction to College Writing

CE

An introduction to college writing. The first of two sequential freshman composition courses, this course emphasizes the process of critical thinking, reading, and writing. Student writing progresses from a personal to an academic perspective. Students write for different audiences and purposes using a variety of rhetorical strategies. Students write in response to reading and are introduced to standard documentation procedures. Students are required to submit a final portfolio that meets department requirements. PREREQUISITE(S): Placement through assessment testing, successful completion of Basic English (ENGL 001 or ENGL 002 with a grade of A), or completion of AELW 940/ELAI 990 with a grade of C or better. Assessment Level(s): READ 120. Three hours each week. Formerly EN 101.

3 semester hours

Course Outcomes:

Upon course completion, a student will be able to:

- Demonstrate the recursive writing process (pre-writing, outlining, drafting, revising, and editing).
- Generate an idea that allows an essay and each of its paragraphs to be unified.
- Use thesis, either clearly stated or implied, as the organizing principle for writing essays.
- Use computers to draft, write, edit, and revise papers according to a standard manuscript format.
- Apply the writing process under a time constraint to respond to a variety of academic situations.
- Incorporate appropriate feedback from peers and instructors when revising essays and provide effective peer feedback .
- Assess his or her own writing progress and recognize areas for improvement .
- Select and prepare appropriate writing assignments to be included in final portfolios.
- Write a minimum of 4 essays of three pages or more (approximately 750-1,000 words), including an in-class essay independent of external feedback and of a length appropriate to the timed setting.
- Write a self-assessment essay of 3 or more pages (approximately 1,000 words).
- Develop unified essays using personal observations, critical thought, and readings.
- Develop logical and coherent college-level essay structure.
- Use rhetorical strategies, based on audience and purpose, to develop academic essays with a balanced expository exploration of a topic.
- Write essays that demonstrate facility with grammar and mechanics.
- Summarize and analyze college-level readings.
- Articulate and support a position in response to readings.
- Develop own ideas in relation to words and ideas of others.
- Integrate information into essays by quoting, paraphrasing and summarizing, based on assigned readings.
- Demonstrate standard citation and documentation procedures.
- Write with academic integrity; recognize and avoid plagiarism.

ENGL 102 - Critical Reading, Writing, and Research

(ENGF)

Studies in argumentation and research. A second of two sequential freshman composition courses, this course is designed to help students learn to identify, critically read, analyze and evaluate, and write arguments using logic and appropriate rhetorical techniques. Students construct thesis-driven academic essays, synthesizing and incorporating the words and ideas of others and using formal documentation. Students learn to identify audience as well as employ effective tone, word choice, and sentence patterns. PREREQUISITE(S): A grade of C or better in ENGL 101 or ENGL 101A or consent of department. Three hours each week. Formerly EN 102. 3 semester hours

Course Outcomes:

Upon course completion, a student will be able to:

- Write multiple-page essays and workplace documents that demonstrate critical thinking - including an 810 page research paper - that meet college-level standards for content, organization, style, grammar, mechanics, and format as well as accepted conventions of writing in the workplace.
- Write effective, sound, well-supported arguments using a variety of rhetorical techniques and conventions.
- Manage the research and writing process effectively and show evidence of effective planning for research project methods and resource use.
- Identify and respond effectively to a range of audiences in written and oral assignments.
- Formulate a thesis to anchor development of an argument appropriate to audience and purpose.
- Identify valid issues for research.
- Formulate research questions that aid in exploration and analysis.
- Use traditional library and online research skills to locate and evaluate college-level research materials as well as types of sources appropriate to research and writing.
- Integrate outside information into essays.
- Use appropriate standard documentation procedures in essays.
- Recognize and avoid plagiarism.
- Analyze readings for implied and direct meaning and for tone, audience, and purpose.
- Synthesize a variety of viewpoints to develop an individual argument position.
- Develop and analyze arguments using logic and other appeals.
- Identify and avoid flawed logic or logical fallacies.
- Participate constructively in discourse that may be controversial in nature.

HIST 117 - World History: A Comparative Survey from A.D. 1500 to the Present

(HUMD [M])

One of two related courses (with HIST 116), which may be taken in either order. These courses cover the world's great cultures, religious and political systems. They offer the student an opportunity to understand contemporary life in terms of the accumulated cultural experiences of the world and to appreciate the growing interdependence of modern nations. HIST 117 is a comparative course covering autonomous local developments in the various parts of the world as well as the settling of the New World; the scientific and industrial revolutions and their diffusion; Western dominance of the non-Western world and its decline; the rise of mass societies, Marxism, worldwide revolutions; the effects of two world wars; the struggles to modernize. Assessment Level(s): ENGL 101/ENGL 101A, READ 120. Three hours each week. Formerly HS 117. 3 semester hours

Course Outcomes:

Upon course completion, a student will be able to:

- Appreciate and analyze the diverse cultures and perspectives in a global approach to history.

- Demonstrate understanding of the impact of geography on the development of culture and economy.
- Demonstrate understanding of the development of the industrial revolution and analyze the impact of industrialized nations on the world economy, as well as their impact on specific countries that did not industrialize.
- Explain the growing interdependence of modern nations.
- Analyze the impact of technology and literacy on the emergence of mass societies.
- Explain the impact of ideologies and war on the twentieth century world.

HLTH 105 - Personal & Community Health

(GEIR, GEEL)
Examines the meaning and significance of physical, mental, and social health as related to the individual, society, and the influence they have on each other's behavior and function. The student will use a variety of methods to collect, analyze, interpret, and apply data and information as it relates to health behaviors and the outcomes of these behaviors have on college students, young people, and the local and global communities. Assessment Level(s): ENGL 101/ENGL 101A. Three hours each week. Formerly HE 101.
3 semester hours
Course Outcomes:

- Upon course completion, a student will be able to:
- Analyze current health information and discuss its influence on individuals, diverse cultures, and communities.
- Explain and evaluate how genetics, lifestyle, socioeconomic status and government policies impact the health of the individual and the community
- Identify and discuss how the unique cultural and social factors of being a college student can impact one's health.

MATH 181 - Calculus I

(MATF, GEEL)
MATH 181 and MATH 182 are intended primarily for students of the physical sciences, engineering, and mathematics. An introduction to major ideas of single variable calculus including limits, derivatives, and integrals of algebraic and transcendental functions; applications. PREREQUISITE(S): A grade of C or better in MATH 165, appropriate score on mathematics assessment test, or consent of department. Assessment Level(s): ENGL 101/ ENGL 101A or AELW 940/ELAI 990, READ 120 or AELR 930/ELAR 980. For computation of tuition, this course is equivalent to five semester hours. Five hours each week. Formerly MA 181.
4 semester hours
Course Outcomes:
Upon course completion, a student will be able to:

- Determine when and how to apply the Fundamental Theorem of Calculus.
- Evaluate limits graphically, algebraically, and numerically.
- Explain and distinguish between average and instantaneous rates of change and be able to interpret each within the context of an applied problem.
- Find a derivative directly from the definition of a derivative.
- Identify and apply the appropriate rule(s) for symbolic differentiation.
- Implicitly differentiate a function.
- Interpret derivatives verbally in the context of an application.
- Interpret limits verbally.
- Interpret the definite integral as a limit of sums.
- Interpret the indefinite integral as an inverse process of differentiation and evaluate indefinite integrals.

- Set up and evaluate definite integrals to solve applied problems, such as problems involving area, motion, and net change.
- Use derivatives to determine the extreme values of a function.
- Use derivatives to model and analyze a variety of applications, such as problems involving optimization, related rates, and motion.
- Use first and second derivatives to obtain information about the graph of a function and use the graph of a function to obtain information about its first and second derivatives.
- Use technology to discover, explore, illustrate, and understand limits, derivatives, and integrals.

MATH 182 - Calculus II

CE-R

A continuation of MATH 181. Further differentiation and integration of transcendental functions. Methods of integration with applications, indeterminate forms, improper integrals, Taylor's formula; infinite series; polar coordinates. PREREQUISITE(S): A grade of C or better in MATH 181 or equivalent, or consent of department. For computation of tuition, this course is equivalent to five semester hours. Five hours each week. Formerly MA 182.

4 semester hours

Course Outcomes:

Upon course completion, a student will be able to:

- Evaluate integrals by using the appropriate techniques.
- Approximate definite integrals by using appropriate numerical techniques.
- Find limits involving indeterminate forms.
- Evaluate improper integrals.
- Set up, evaluate, and interpret integrals that represent arc length, area, volume, and average value.
- Set up, evaluate, and interpret integrals that model applications in physics.
- Solve selected differential equations using graphical, numerical, and analytic methods.
- Model applications such as population growth with differential equations.
- Determine the convergence or divergence of sequences and series.
- Represent functions with power series and approximate functions with Taylor polynomials.
- Graph polar equations.
- Use integration to find the area of a polar region.
- Use technology as an appropriate tool.

MATH 280 - Multivariable Calculus

CE-R

Calculus of vector functions; analytic geometry of space; partial differentiation; multiple integrals; classical theorems of Green, Gauss, and Stokes. PREREQUISITE(S): A grade of C or better in MATH 182 or equivalent, or consent of department. For computation of tuition, this course is equivalent to five semester hours. Five hours each week. Formerly MA 280.

4 semester hours

Course Outcomes:

Upon course completion, a student will be able to:

- Describe surfaces parametrically in three-dimensional space and find an equation of a plane.
- Describe and recognize graphs of vector functions and space curves.
- Evaluate limits of functions of several variables.
- Find equations of tangent planes to surfaces.

- Use and apply the Chain rule for derivatives of functions of several variables.
- Use LaGrange's Multipliers method to optimize functions of several variables with additional constraints.
- Find volumes of solids bounded by surfaces.
- Change the order of integration and compute double and triple integrals.
- Determine the surface area of the graph of a function of several variables.
- Use the Fundamental Theorem of Line Integrals and Green's Theorem to compute line integrals.
- Compute the divergence and curl of a vector function.
- Use the Divergence Theorem and Stoke's Theorem to compute surface integrals.
- Use a Computer Algebra System to graph, and solve problems about, functions of several variables, vector valued functions, and vector fields.

MATH 282 - Differential Equations

First order differential equations; higher order linear differential equations and systems of linear equations; solution by power series and numerical methods; the Laplace transform and some applications. PREREQUISITE(S): A grade of C or better in MATH 182 or equivalent, or consent of department. Three hours each week. Formerly MA 282.
3 semester hours
Course Outcomes:
Upon course completion, a student will be able to:

- Use qualitative and numerical methods to analyze the family of solutions to a first-order differential equation, particularly an autonomous equation.
- Solve first-order separable and linear differential equations and corresponding initial-value problems.
- Determine the domain of a solution and describe long-term behavior of a solution.
- Know and be able to apply the theorem for existence and uniqueness of solutions to a first-order differential equation.
- Write and solve a first-order initial-value problem that models a practical situation involving a rate of change.
- Rewrite a second-order differential equation as a system of first-order equations.
- Use qualitative and numerical methods to describe and analyze the family of solutions to a first-order system.
- Write a first-order system in matrix form, find the eigenvalues and write the general solution to the system.
- Assume exponential solutions and solve a homogeneous or non-homogeneous linear second-order differential equation with constant coefficients.
- Understand and interpret the solutions to a second-order equation in terms of harmonic oscillator.
- Use Laplace transforms to solve first- and second-order initial-value problems when the differential equation may be forced by a continuous or discontinuous function.
- Use an advanced software tool (Maple, MATLAB, Mathematica, ODE software, and the like) appropriately and effectively to aid in understanding the behavior of solutions to differential equations.

PHYS 161 - General Physics I

(NSND, GEEL)
Fundamental laws of motion, force and energy, particle collisions, rotational mechanics, gravitation, thermodynamics, and kinetic theory. A calculus-based general physics course, required for students majoring in engineering or one of the physical sciences. PREREQUISITE(S): MATH 181. PRE- or COREQUISITE(S): MATH 182 or consent of department. Three hours lecture, one hour discussion each week. Formerly PH 161.

3 semester hours
A calculus-based general physics course, required for students majoring in engineering or one of the physical sciences.
Course Outcomes:
Upon course completion, a student will be able to:

- Apply scientific methods to investigate physical concepts associated with classical mechanics and thermodynamics.
- Identify and apply physical principles and laws associated with classical mechanics and thermodynamics.
- Integrate different concepts, laws and principles to explain practical applications in classical mechanics and thermodynamics.
- Develop strategies to solve physics problems involving classical mechanics and thermodynamics.
- Apply calculus techniques to solve problems involving classical mechanics and thermodynamics.
- Build and analyze graphical representations of specific physical quantities and laws associated with classical mechanics and thermodynamics.
- Use correct and complete quantitative analysis, use estimation and dimensional analysis, and draw correct and relevant conclusions related to classical mechanics and thermodynamics problems.
- Identify reliable sources of information and use their content to answer conceptual mechanics and thermodynamics questions.

PHYS 262 - General Physics II: Electricity and Magnetism

(NSLD, GEEL)
Coulomb's Law, electric fields, Gauss' Law, direct current and alternating current circuits, magnetic fields, the laws of Ampere and Faraday, and electromagnetic waves. Laboratory exercises also develop familiarity with electrical measuring instruments. PREREQUISITE(S): A grade of C or better in both MATH 182 and PHYS 161 and concurrent enrollment in MATH 280 or MATH 282, or consent of department. Three hours lecture, three hours laboratory, one hour discussion each week Formerly PH 262.
4 semester hours
A calculus-based general physics course, required for students majoring in engineering or one of the physical sciences.
Course Outcomes:
Upon course completion, a student will be able to:

- Solve mechanical and electrical oscillating system problems.
- Use Excel or a similar computational graphing tool to graph and fit curves.
- Find solutions to simple resistive DC circuits using KVL and KCL.
- Measure Hooke's Law parameters for a mass-spring system and make comparisons to the electrical analogy for such in a system to AC circuits.
- Demonstrate understanding of Ohm's Law for resistors, and also the constitutive defining relations for capacitors and inductors.
- Combine resistances and capacitances in series and parallel.
- Compute resistances, capacitances, and inductances for simple geometries and understand the effect of conductive, dielectric, and magnetic media for such geometries.
- Verify Ohm's Law and Kirchoff's Laws by using typical electrical measurement devices which measure currents, voltages, resistances, etc.
- Use Coulomb's Law to calculate electric forces and electric fields due to point charges and continuous charge distributions.
- Use Gauss's Law to calculate electric fields for highly symmetric continuous charge distributions.
- Demonstrate understanding of the fundamental operating principles of a Cathode Ray Tube.

- Use the Coulomb's Law form of electric potential to compute the electric potential for point charges and continuous charge distributions.
- Compute the potential differences due to a given electric field.
- Solve simple problems involving electric energy and work.
- Demonstrate understanding of the field viewpoint versus the action-at-a-distance viewpoint of electric and magnetic forces.
- Apply Faraday's Law and Lenz's Law to problems with magnetic fields, both with constant and time-dependent magnetic flux.
- Solve simple DC-Circuit problems such as RC, RL, RLC circuits with various characteristics involving the "charging", "discharging", and "relaxation" of such circuits.
- Solve simple AC-Circuit problems involving characteristics such as impedances, resonance, power, phase, etc.
- Use the oscilloscope to measure time-varying voltages, frequencies, periods, amplitudes, phase, etc.
- Analyze and measure major circuit characteristics for RC, RL, RLC circuits driven by a square wave, and also sinusoidal AC-circuit configurations.
- Compute the magnetic forces on moving charges and wires.
- Use Biot-Savart Law to compute the magnetic field for simple current distributions.
- Use Ampere's Law to solve simple problems computing the magnetic field.

PHYS 263 - General Physics III: Waves, Optics, and Modern Physics

(NSLD, GEEL)
Physical and geometrical optics, quantum mechanics, selected topics in nuclear physics, solid state physics, and related fields. PREREQUISITE(S): A grade of C or better in PHYS 262 or consent of department. Three hours lecture, three hours laboratory, one hour discussion each week. Formerly PH 263.
4 semester hours
A calculus-based general physics course, required for students majoring in engineering or one of the physical sciences.
Course Outcomes:
Upon course completion, a student will be able to:

- Demonstrate understanding of the distinction between Transverse and Longitudinal Waves and predict which will be supported in various media.
- Solve the differential wave equation for the simplest cases.
- Relate period, frequency, wavelength, and velocity for harmonic waves.
- Apply the concept of linear superposition to standing waves and mechanical resonance.
- Apply general concepts of mechanical waves to a variety of contexts such as musical instrument design, supersonic flight, ultrasonic testing of materials, etc.
- Demonstrate understanding of how electromagnetic waves are predicted by Maxwell's equations.
- Analyze experimental results and derive valid conclusions related to the wave properties of light.
- Improve mastery of skills related to Phasor Diagrams and AC Circuit Analysis.
- Analyze experimental results and derive valid conclusions related to the geometrical optics of lenses and mirrors which predate the wave picture of light.
- Explain the significance of the many new discoveries of modern physics at the turn of the 20th century which challenge prior classical ideas of particle, waves, and energy. Specifically, discoveries such as the photoelectric effect, X-rays, etc.
- Use prior application of wave theory together with statistical concepts to explain early quantum discoveries.

- Apply math techniques such as Separation of Variables and the solution of Boundary-Value problems to solutions of simple problems in wave theory and quantum mechanics.
- Describe how Relativity developed from a re-examination of the nature of space and time and lead to new connections between concepts of mass and energy.
- Solve simple problems related to Relativity.
- Apply the basic principles of modern physics to simple problems and models involving atomic structure, nuclear structure, and radiation.
- Demonstrate understanding of the various applications of Quantum Physics to medicine, industry, engineering, etc.
- Demonstrate understanding of the applications of Nuclear Physics as it relates to the "energy resource problem", alternative energy resources such as wind, tides, geothermal, biomass, etc. and the future of the "energy problem".
- Demonstrate understanding of some basic ideas in Particle Physics and Cosmology.