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CHAPTER VII

The Academic Program

Division of Engineering and Weapons

Department of Aerospace Engineering
Department of Electrical Engineering
Department of Mechanical Engineering
Department of Naval Systems Engineering
Department of Weapons and Systems Engineering

Department of Aerospace Engineering

Aerospace Engineering Major

Aerospace Engineering, a major accredited by the Accreditation Board for Engineering and Technology (ABET), focuses on the study of compressible and incompressible fluid flows, conventional and advanced propulsion systems, vehicle performance, stability and control, and modern structural mechanics. It deals primarily with the analysis and design of air cushion vehicles, aircraft and spacecraft. Basic principles and sound engineering techniques are stressed.

The curriculum provides for various research projects and choice of a wide variety of electives. Throughout the program, extensive use is made of laboratory facilities, which include a propulsion lab; a rotor lab; low speed, transonic, and hypersonic wind tunnels; and a structures lab. Field tests are also conducted using a flight test aircraft, small surface-effects vehicles, and a variable stability flight simulator. Computer techniques are emphasized for data reduction, design, and graphic display.

A solid foundation is laid which permits graduate work in a number of fields. A Bachelor of Science in Aerospace Engineering is awarded.

Curriculum Requirements (In addition to the requirements of plebe year)
Professional: NN203, NS252, NL200, ES500, NN302, NL300, NS300, *NL400;
Mathematics: SM201 or SM211 or SM251, SM212, SM311;
Science: SF211, SF212;

"Academics are a lot rougher than I expected. If all I had to worry about was my studies, it probably wouldn't be so bad . . ."
**“It cannot be too often repeated that in modern war, and especially in modern naval war, the chief factor in achieving triumph is what has been done in the way of thorough preparation and training before the beginning of war.”**

President Theodore Roosevelt

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**Aerospace Engineering Courses**

**EA202 Principles of Flight** (2-2-3). Gives a broad overview of aerospace engineering. Topics covered include history of flight, the earth's atmosphere, fluid statics, introductions to fluid dynamics, thermodynamics, aerodynamics, and gasdynamics; and the performance, propulsion and stability and control of flight vehicles.

**EA301 Aerodynamics** (3-0-3). Covers the following topics in theoretical aerodynamics: vector fluids, potential flow, thin airfoil theory, finite wing theory, and introduction to boundary layer. Prereq: EA202.


**EA317 Flight Performance** (2-2-3). The basic principles of aerodynamics are extended to include flight vehicle analysis. Modern methods of finite wing analysis are introduced. The time-sharing computer is used to aid in the analysis of typical flight performance problems. Prereq: EA202.

**EA323 Aerospace Structures I** (2-2-3). Applications of statics, dynamics and solid mechanics to the design of flight vehicle structures. Topics include energy methods, generalized bending, elastic center, shear flow in semimonocoque structures, and indeterminate space trusses. Finite-element solution techniques are introduced. Prereq: EM217.

**EA331 Gasdynamics I** (2-2-3). A comprehensive coverage of the methods of gasdynamics in internal and external flow systems, including thermodynamics of perfect and real gases and fundamental theorems of one-dimensional compressible subsonic and supersonic flows. Prereq: EA202 or EM324, SM222, and EM319.

**EA411 Orbital Mechanics** (3-0-3). A vector mechanical two-body treatment of ballistic missile and spacecraft trajectories. Included topics are: orbit determination, in-plane and out-of-plane orbit changes, position and velocity as a function of time, rendezvous, and vehicle accuracy as a function of launch errors. Prereq: SM212, EM312.

**EA413 Stability and Control** (3-0-3). The aerodynamic and inertial forces and moments acting on the flight vehicle and its component parts are analyzed to determine their effect on static and dynamic stability. Prereq: EM313, EA202, EM319.

**EA415 Elements of Flight Test Engineering** (2-2-3). A flight laboratory course designed to provide practical application of theoretical principles learned in prior courses dealing with flight performance, aerodynamics, and stability and control. In-flight laboratories are conducted in the departmental aircraft. Prereq: EA202.


**EA422 Aeroelasticity** (3-0-3). Analysis of the coupling of aerodynamic forces on lifting surfaces to structural response associated with flexible aircraft. Topics include fundamentals of vibrations of structural systems, deformations and motions of aircraft structures, wing divergence, control effectiveness and aileron reversal, flutter of surfaces, and aeroelastic testing. Prereq: EA421 or EA301.

**EA431 Gasdynamics II** (3-0-3). Non-steady compressible flow analysis including influence coefficients, viscous and thermal effects, detonation and deflagration, shock tube theory, pressure exchange and combustion, dynamic flow machines, and thrust generators. Prereq: EA331.

**EA433 Flight Propulsion** (2-2-3). The principles of fluid dynamics and thermodynamics are specialized to the problem of propulsion of aircraft and space vehicles. Prereq: EM215, EM324 or EA301.

**EA435 The Aerodynamics of V/STOL Aircraft** (3-0-3). An advanced course covering the aerodynamics of vertical and short take-off and landing aircraft, including fixed wing and rotary wing types, with major emphasis on the helicopter. Prereq: Approval of instructor.

**EA440 Aerospace Vehicle Design** (1-4-3). Preliminary design of a flight vehicle. Includes preliminary layout, weight and balance estimates, performance analysis, stability analysis, and structural analysis. Detailed consideration will be given to one aspect of the design. Prereq: EA323, EA433, EA413.
EA450 Computer-Aided Design in Engineering (2-2-3). The underlying concepts for manipulation of 2-D and 3-D objects using interactive computer graphics techniques are discussed. Curve fairing and fitting, including least squares, cubic spline, Bezier, and B-spline techniques is discussed. Extensions of 3-D surfaces are discussed. An introduction to numerical control part programming, including practical application, is given. The integration of these concepts into computer-aided design and computer-aided manufacturing (CAD-CAM) systems is discussed and demonstrated. Prereq: 1/C or 2/C standing.

EX437 Principles of Surface-Effect Vehicles (3--0--3). The governing parameters of air suspension; types and principles of cushioncraft and surface effect vehicles; dynamics of cushion vehicles, plenum chambers, peripheral jets, and wings in ground effect. The external aerodynamics of surace effect vehicles, flight over land and water, drag, and wave interaction. The internal aerodynamics of duct flow, fan design and valving. Various propulsion schemes and structural designs. An actual two-man hovercraft is used to support the lectures. Prereq: EM324 or EM319 or EA301 or permission of instructor.

Department of Electrical Engineering

Electrical Engineering Major

Electrical Engineering, an ABET-accredited major, combines analysis techniques and experimentation to place primary emphasis on fundamental principles. The resulting basic background, supported by the analytical skills developed, equip the graduate for growth and contributions in the expanding and vital fields of electronics, communications, data acquisition, and data processing and display which permeate today's Navy. Outstanding research facilities support the program of study. A Bachelor of Science in Electrical Engineering is awarded.

Curriculum Requirements (In addition to the requirements of plebe year)
Professional: NN203, NS252, NL200, ES300, NN302, NL303, NS300,* NL400; Mathematics: SM211, SM212, SM311; Science: SP221, SP222, SP226, SP431; Humanities/Social Sciences: HE300* and four electives courses; Language: none required; Special: EM214, EE221, EE222, EE322, EM318, EM319, EN201, ES410; Major: EE341, EE342, EE421, EE352, EE423; plus at least three of the following: EE431, EE432, EE451, EE452, EE461, EE462, EE471, EE472, ES409, ES414, (or ES415), SP436, SP321; Restricted elective: one.
* Taken during second class summer

Electrical Engineering Courses

EE221 Introduction to Electrical Engineering (3-2-4). Terminal characteristics of passive linear and nonlinear devices and energy sources are introduced. Network combinations of these devices are analyzed in the steady state. In addition to mesh and nodal analysis by computer techniques, concepts of equivalence and network theorems are studied in detail. Prereq: SM12.

EE222 Circuit Analysis I (3-2-4). This course treats topics in linear and nonlinear network analysis: time-invariant and time-varying resistance, inductance, and capacitance; impulse response and its convolution; state variables; negative-resistance oscillation and limit cycles; digital computer methods for solving and checking network equations. Prereq: EE221.

"An officer is much more respected than any other man who has so little money."

SAMUEL JOHNSON
“In no other profession are the penalties for employing untrained personnel so appalling or so irrevocable as in the military.”

**General Douglas MacArthur**
and digital as well as analog processing. Prereq: EE451.

EE452 Semiconductor Electronics (3-2-4). An introduction to the physics and technology of planar silicon devices. The p-n junction is considered in detail and is followed by a treatment of junction transistors and junction field-effect transistors. Also surface effects and surface-controlled devices; theory of semiconductor surfaces, surface effects on p-n junctions and the MOS field-effect transistor are discussed. The laboratory entails a special report. Prereq: EE451.


EE471 Microwave Systems (3-2-4). Fundamental radar design concepts including application of the radar equipment to CW, FM-CW, MTI, and pulsedoppler radar. Characteristics of microwave components such as power sources, amplifiers, filters, waveguides, and antennas. System performance analysis with emphasis on signal detection and information extraction in an environment corrupted by noise, clutter, and target scintillation. Prereq: SP441.

EE478 Naval Sensors (3-0-3). Theoretical principles of passive and active naval sensors operating within the frequency spectrum from audio to visible. Emphasis on conceptual fundamentals which bind together seemingly diverse sensor systems such as: sonar, navigation, radio, television, radar, EMC, ECCM, IFF, laser range finders, infrared imagers, and LLLTV. Prereq: EE471 or SP441.

Department of Mechanical Engineering

Mechanical Engineering Major

Mechanical Engineering, an ABET-accredited major, is the most diverse of the engineering curricula. A sound background in engineering fundamentals, science, and mathematics is provided, and the range of electives offers concentration in several specialized areas of engineering.

In addition to centralized classrooms, shops, analog and digital computing systems, and other interdisciplinary laboratories, the department maintains such diverse facilities as a materials science laboratory complex, dynamics and physical systems laboratory, a solid mechanics laboratory complex, and a thermodynamics and fluid dynamics laboratory. A Bachelor of Science in Mechanical Engineering is awarded.

Curriculum Requirements (In addition to the requirements of plebe year)
Professional: NN203, NS252, NL200, ES300, NN502, NL303, NS500,* NL400;
Mathematics: SM201 or SM211 or SM251, SM212, SM311;
Science: SP211 and SP212;
Humanities/Social Sciences: HE300,* FE210 plus three electives;
Language: none;
Special: EM217, EM231, EM232, EM313, EM324, EE331, EE332, ES410;
Major: EN201, SM311, EM320, EM377, EM411, EM471, EM472, plus four approved electives;
Restricted elective: one.
* Taken during second class summer.

"Any healthy organization can survive individual divergencies, and may even profit from them. Compulsory unification of opinion can only achieve the unanimity of the graveyard."

VICE ADMIRAL HYMAN RICKOVER
General Engineering Major

The General Engineering major provides the student with a basic technical education in mathematics, science, engineering fundamentals, and naval professional engineering subjects. It is intended to provide an adequate background for future naval technical training and education. Midshipmen completing the General Engineering major receive a nondesignated Bachelor of Science degree. The major is not accredited by ABET.

Curriculum Requirements (In addition to the requirements of plebe year)
Professional: NN203, NL200, EN200, NS252, NS300, NN303, NN302, EN300, ES300, EE311-312, ES400, NL400;
Mathematics: SM201 or SM211 or SM251 and SM212;
Science: SP201 or SP211 or SP221; SP202 or SP212;
Humanities/Social Sciences: HE300* and four approved electives;
Language: none;
Special: none;
Major: EN201, EM214, EM217, EM231, EM232, EM327, EM328, EE313, EN405 plus two approved electives;
Restricted elective: one.
* Taken during second class summer

Mechanical Engineering Courses

EM214 Elements of Materials Science (2-2-3). An introductory course in the physical, electrical and mechanical properties of engineering materials including their structures, use in engineering application, environmental effects, and modes of failure. Prereq: 4/C Chemistry; Coreq: Calculus III.

EM217 Strength of Materials (3-2-4). A first course in mechanics of deformable bodies with emphasis on the engineering approach to the response of these bodies to various type loadings. Topics include stress-strain relationships, stress-strain analysis, load-deflection, bending, torsion, buckling, temperature effects, and dynamic response. Prereq: EM231; Coreq: SM212.

EM221 Introduction to Statics (2-0-2). An introductory course in the principles of static equilibrium. The systems studied consist of rigid bodies subjected to forces and moments. The use of the free-body diagram is stressed in the solution of problems. Prereq: SP201 or equivalent.

EM231 Statics (2-0-2). An initial course in applied vector mechanics with emphasis on static equilibrium. Topics include forces, moments, couples, equivalent force-couple systems, centroids, distributed forces, and Coulomb friction. The application of the free body diagram in the analysis of static equilibrium of frames, machines and trusses is stressed. Prereq: 4/C mathematics; Coreq: Calculus III and General Physics I.

EM232 Dynamics (3-0-3). A course in classical vector dynamics. Topics include vector algebra and calculus, kinematics of particles and rigid bodies, as well as the use of Newton's and Euler's second laws, energy and momentum methods involving problems for particles and rigid bodies. Prereq: EM231; Coreq: SM212.

EM313 Materials Science (3-2-4). An introductory course in the physical and mechanical properties of engineering materials (including metals, ceramics, and plastics), their structures, use in engineering applications and failure phenomena. All laboratory projects are structured to provide strong physical illustrations for the topics covered in lectures. Prereq: EM217.

EM318 Applied Fluid Mechanics (3-0-3). A first course in incompressible fluid mechanics. Topics include properties of fluids, fluid statics, integral conservation equations, differential field analysis, dimensional analysis and similitude, incompressible boundary layers, viscous flow in conduits, and flow about immersed bodies. Prereq: EM319 or equivalent.
EM319 Engineering Thermodynamics (3–0–3). A basic thermodynamics course in which the first and second laws of thermodynamics are studied primarily from the classical macroscopic viewpoint and applied to both closed and open systems. Working substances include perfect gases, real gases and vapors in addition to solids and liquids. Naval applications are emphasized. Coreqs: SM212.

EM320 Applied Thermodynamics (2–2–3). Laboratory equipment which operate on principles of thermodynamics and fluid mechanics is used to reinforce a study of gas and liquid power cycles, refrigeration and air conditioning, ship and aircraft propulsion systems, combustion, energy conversion, and compressible flow. Prereq: EM319 or equivalent.

EM324 Fluid Dynamics (3–2–4). An introductory course in fluid dynamics stressing both the integral and differential forms of the conservation laws of fluid flow. Engineering applications are made to hydrostatics and to ideal and real fluid flows. Laboratory experiments and problem sessions complement the lectures. Prereq: EM319 or equivalent.

EM327 Essentials of Fluid Dynamics (3–0–3). An introductory study of the behavior of fluids at rest and in motion. Effects of various fluid properties and forces on flow patterns, and force interaction between fluid and its boundaries are presented. Prereq: SM212 or SM202.

EM328 Thermodynamics (3–0–3). An introductory course in classical thermodynamics stressing the understanding and application of the basic laws of thermodynamics. A logical development of the relationships among physical properties of interest in the thermal sciences is also presented. Prereq: SM212.

EM371 Introduction to Design (2–2–3). Fundamentals of mechanical design, with emphasis on the design of pertinent machine elements. Topics such as fasteners, springs, anti-friction bearings, lubrication and journal bearings, gearing, and shafts are covered. Prereq: EM321, SM212; Coreq: EM222.


EM425 Process Dynamics (2–2–3). Ship propulsion system elements such as pressure vessels and heat exchangers are described by mathematical models. Theoretical responses are compared with pilot plant outputs. Predictive power of the mathematical models is improved by parameter adjustment. Prereq: SM212.

EM426 Process Control (2–2–3). Mathematical models are developed for typical shipboard systems where thermodynamic variables such as temperature and pressure are controlled automatically. Theoretical considerations of combined stresses are compared to outputs of pilot plant models of these same systems. Prereq: SM212.

EM431 Experimental Stress Analysis (2–2–3). Theoretical considerations of combined stresses are compared with experimental methods. Electrical resistance strain gage, photoelasticity, moiré, and brittle-coating techniques are studied in detail and extensively used in the laboratory. Prereq: EM217.


EM434 Advanced Mechanics of Materials (3–0–3). Topics include theories of elasticity and plasticity, stress and strain as tensors, compatibility and constitutive relationships, energy methods, stability, yield functions, behavior of time dependent materials, plasticity limit theorems, plastic design. Prereq: EM317 and SM311.

EM442 Computer Graphics and Engineering Mechanics (3–0–3). Mathematical theory of computer graphics, including curves, surfaces, transformations, and projections. Use of computer graphics to analyze the behavior and calculate the properties of mechanisms such as cams, gears, and 4-bar linkages. Prereq: 1/C or 2/C standing.

EM443 Energy Conversion (3–0–3). Introduction to energy conversion and utilization. Terrestrial and thermodynamic limitations, direct energy conversion devices, alternative energy sources, present and future energy research and development, and energy usage and economy are presented. Prereq: EM319 or equivalent.

EM444 Computer Graphics and Engineering Mechanics (3–0–3). Mathematical theory of computer graphics, including curves, surfaces, transformations, and projections. Use of computer graphics to analyze the behavior and calculate the properties of mechanisms such as cams, gears, and 4-bar linkages. Prereq: 1/C or 2/C standing.

EM445 Compressible Flow and Turbomachinery (3–0–3). Fundamental principles of undergraduate fluid mechanics and thermodynamics are used to study one-dimensional compressible flow phenomena and the analysis and design of the turboma-

“...still am. To me it’s a step up going to the Naval Academy ... The biggest step to me is that I did it all on my own.”
"I'm really not that smart. I have to work at it. I don't fool around in class. I listen to the professor and I know how to study."

chinery and turbomachinery components. Prereq: EAS19 & EAS34 or equivalent.

EM453 Physical Metallurgy (3-0-3). Study of the principles of physical metallurgy including imperfections in crystal structures, liquid and solid phases of metals, phase transformations, and solid-state reactions with applications to metallurgical processes such as casting and welding. Prereq: EM313.

EM454 Mechanical Behavior of Materials (2-0-3). Treatment of the mechanical properties and behavior of materials. Elastic, plastic, viscous, and viscoelastic behavior are treated, as well as modes of failure including brittle and ductile fracture. Rupture, stress corrosion cracking, creep, and fatigue are also considered. Prereq: EM314 or EM313 and EM217.

EM461 Combustion: Principles and Applications (2-2-3). An introductory course in combustion science covering basic principles and applications. Fuel science topics such as solid, liquid, and gaseous fuel sources, heating values of fuels, combustion products, and environmental impacts are covered. The principles of combustion are then applied to a variety of internal and external combustion systems both analytically and experimentally. Prereq: EM319, EM324 or equivalent.

EM471 Mechanical Engineering Experimentation (1-4-3). Planning experiments and making measurements. Statistical inference plans; data analysis; detailed work on thermocouples and strain gages; pressure, flow, vibration, and other measurements; and testing for signal validity. Prereq: I/C standing in Mechanical Engineering major or approval of department chairman.

EM472 Mechanical Design (2-2-3). A detailed study of the engineering design process through lectures and case studies emphasizing design phases, engineering economics, and program management. Practical experience is gained by participation in team projects. Prereq: EM371, or approval of department chairman.

Department of Naval Systems Engineering

Marine Engineering Major

This ABET-accredited major is concerned with the analysis and design of energy systems. Students completing this program can expect to continue their education in the Navy's Nuclear Power Program or in graduate school.

A broad background in engineering fundamentals is provided students, who then apply these principles in their studies of energy systems. These include conventional steam and nuclear power plants, gas turbines, and such advanced power systems as fuel cells and thermoelectric units.

A course covering the principles of naval engineering systems develops an understanding of the principles of ship design and construction and introduces students to the problems of analyzing and designing systems for use in the ocean environment. Studies in modern physics prepare them for the reactor physics and reactor engineering courses. Studies in heat transfer—so essential in the study of modern energy systems—follow. Knowledge gained from these studies is then used in the analysis of marine propulsion plants and in group designs of future propulsion systems.

Past designs by students have included the concept design of a propulsion plant for a low-water-plane catamaran, preliminary design of a submarine waste disposal system, and the concept design of an offshore nuclear power plant. A Bachelor of Science in Marine Engineering is awarded.

Curriculum Requirements (In addition to the requirements of plebe year)
Professional: NN203, NS252, NL200, ES300, NN302, NL303, NS300,* NL400;
Mathematics: 5M211, 5M212;
Science: SP211, SP212;
Humanities/Social Sciences: HE300* and four electives;
Language: none;
Naval Architecture Major

Naval Architecture, an ABET-accredited major, unlike most engineering disciplines unified by the nature of the phenomena involved, originally came into being as a discipline because of a single end-product, the ship. A special combination of knowledge and experience is needed to develop, design, and build this single product. Variety exists not only in the kinds of work (design, research, cost estimation, management, etc.), but also in the types of craft involved—from sail boats to aircraft carriers, from hydrofoil boats to catamarans, from submarines to surface-effect vehicles.

Naval architects use both art and engineering in designing ships. Armed with imagination and experience, they convert functional requirements into a suitable, cost-effective design. They analyze and select the best dimensions and hull form; they calculate the power requirements and estimate the weights of the principal components. They design and analyze the hull structure and decide on the location of military subsystems, machinery spaces, accommodations, and stores. Additionally, the ship must be divided into watertight compartments so that, if damaged, the

"I never had to study in high school. Never . . . When I first came in here I didn’t know what to do, like one step forward, two steps back."
chances of survival are maximum. Weighing and compromising all such conflicting
needs in the design of the ship are the creative and challenging responsibilities of the
naval architect.

Naval architecture at the Naval Academy treats most of the preceding facets through
a fully integrated program of classroom sessions, hands-on laboratory work, field
trips, and the latest in computer-aided design and analysis techniques. A Bachelor of
Science in Naval Architecture is awarded.

Curriculum Requirements (In addition to the requirements of plebe year)
Professional: NN203, NS252, NL200, ES300, NN302, NL303, NS300,* NL400;
Mathematics: SM211, SM212;
Science: SP211, SP212;
Humanities/Social Sciences: HE300* and four electives;
Language: none;
Special: EM217, EM231, EM232, EM319, EM324, EE331, EE332, ES410;
Major: EN201, EN242, EN351, EN352, EN356, EN361, EN382, EN453, EN459, EN460,
plus two approved electives;
Restricted elective: one.
* Taken during second class summer

Ocean Engineering Major

Ocean Engineering, an ABET-accredited major, is the key to the last frontier on earth—the
deep ocean. This is an interdisciplinary field involving the application of engineering
principles to hardware systems in the ocean environment. The curriculum stresses fundamentals of mathematics, physics, mechanical engineering, electrical
engineering, and oceanography, followed by the application of these fundamentals
in ocean engineering courses which include analysis of ocean materials, power systems,
underwater sound, wave mechanics, life-support systems, ocean energy, and a wide
variety of ocean vehicles and offshore and coastal structures.

Laboratory experiments are conducted in the 120-foot towing tank and coastal
engineering basin. Both are equipped with pneumatic wave-maker and instrumented
with sophisticated sensors and on-line data acquisition and analysis equipment. The
Naval Academy’s computer systems are used in solving design problems. Sediment
laboratory and environmental chamber facilities are also available. Midshipmen have
designed and are building an undersea habitat which will be used as a field laboratory.
A Bachelor of Science in Ocean Engineering is awarded.

Curriculum Requirements (In addition to the requirements of plebe year)
Professional: NN203, NS252, NL200, ES300, NN302, NL303, NS300,* NL400;
Mathematics: SM211, SM212;
Science: SP211, SP212;
Humanities/Social Sciences: HE300* and four electives;
Language: none;
Special: EM217, EM231, EM232, EM319, EM324, EE331, EE332, ES410;
Major: SO221, SP411, EN201, EN241, EN351, EN356, EN361, EN382, EN441, EN460, EN473, plus
three approved electives;
Restricted elective: one.
* Taken during second summer
Naval Systems Engineering Courses

EN100 Introduction to Naval Engineering (2-0-2). An introduction to the components, function, and basic operation of the various common propulsion systems and auxiliary engineering equipment used by the naval service, including safety considerations involved with shipboard equipment. Also ship's stability, damage control, electrical distribution, hull construction, and hydraulics.


EN201 Engineering Design Graphics (0-2-1). An introduction to engineering graphical methods and disciplines with emphasis on special visualization and design. Topics include orthographic projection, axonometric drawing, and descriptive geometry.

EN241 Introduction to Naval Systems Engineering (3-0-3). This course provides an application of basic mathematics, physics, and mechanics to marine vehicles and static marine systems. It provides a background in naval architecture and ocean engineering to prepare a midshipman for future major electives offered by the department. Specific topics include ship stability, resistance and powering, maneuvering principles, materials in the ocean, and marine structural principles. Prereq: EM231 or permission.

EN242 Introduction to Naval Architecture (1-2-2). Provides a technical overview of engineering areas of the naval architecture curriculum. A ship's-line drawing is created in the laboratory. Introduces the specialized nomenclature and engineering tools of the naval architect. Prereq: EN201, EM231.

EN300 Naval Engineering II (3-2-4). A study of naval engineering systems, including the principles of energy conversion, the basic operation of steam, gas turbine, nuclear, and internal combustion engine powerplants; and shipboard engineering department operations. Prereq: EN100, Physics I, 3/C cruise.

EN351 Ship Hydrostatics (3-2-4). Transverse and longitudinal stability of both surface ships and submersibles are studied. Flooding and stability of ships in the damaged condition are covered. Digital computers are used to solve hydrostatic problems. Prereq: EM231.

EN352 Resistance and Propulsion (3-0-3). Topics: dimensional analysis, similitude, wave and viscous resistance of ships, ship-model testing techniques, full-scale performance prediction, momentum theory of propulsive devices, and propeller vibrations and design Prereq: EN351, EM324.

EN358 Ship Structures (3-2-4). A course in structural theory and practice. Topics include longitudinal and transverse strength of the hull girder, bending moments in a seaway, plate theory, development of the ship's structural design, submarine pressure hull design and shipbuilding materials. Prereq: EM217, EN351.

EN361 Marine Power Systems (2-2-4). This is a case study type of course in which the students use theoretical thermodynamics and fluid mechanics in order to analyze a typical ship's power plant. Steam and gas turbine plants are covered. Energy from conventional means is studied and energy from nuclear sources is discussed. In the laboratory the student receives a hands-on relationship with steam and gas turbine plants and works out the performance characteristics of the various components. Prereq: EM319, EM324, concurrent, EN241 or EN351.

EN362 Reactor Physics I (3-0-3). An introductory course in nuclear reactor theory covering fission, neutron diffusion, material and geometric buckling, and the critical equation. Bare and reflected homogeneous reactors are studied. Prereq: EM212 or equivalent.

EN363 Ocean Materials Science and Engineering (2-2-4). The course deals with the optimal use of materials in ocean systems with emphasis on corrosion prevention. Laboratory projects include heat treatment, mechanical testing of metals, and corrosion and fouling studies. Prereq: EM217.

EN405 Naval Applications of Thermodynamics (2-2-3). This course provides practical application for the thermodynamics principles previously acquired concentrating on marine propulsion systems and their components in the form of actual propulsion plant case studies and laboratories. The student is expected to understand the interrelationships between components of a given propulsion plant and the application of basic thermodynamics, fluids, and heat transfer theory to these systems. Prereq: EM319 or EM328, General Engineering major.

EN410 Seafloor Mechanics (2-2-3). A study of the basic principles of soil mechanics as applied to marine sediments. Topics include shear strength, consolidation, slope stability. Prereq: EN241 or permission.

EN420 Coastal Engineering (2-2-3). A study of littoral drift and wave action on coastal structures. Topics include littoral drift past a river estuary, breakwaters, jetties, groins, and harbor design. Prereq: EM217, EM324 or equivalent.

EN441 Ocean Engineering Structures (3-0-3). Structural design considerations for fixed ocean structures, mooring systems, and undersea vehicles are analyzed. Design techniques including matrix methods and finite element analysis are introduced. Boundary conditions, wave effects, foundations, loading, and materials considerations are studied. Prereq: EM217.

"The novelty of being a girl is not the hardest part of being here. Just being a plebe is the toughest."
“Nobody can actually duplicate the strain that a commander is under in making a decision in combat.”

ADMIRAL ARLEIGH A. BURKE

EN450 Engineering Economic Analysis (3–0–3). Basic methods and reasons for conducting an engineering economic study are presented. Economic criteria are developed. Procedures for making a selection from amongst a set of technically feasible alternatives are studied. Assumptions and implications associated with these decision-making procedures are discussed. Prereq: FE210, 1/C standing.

EN453 Seakeeping and Maneuvering (3–0–3). Topics: ship steering, maneuvering, motion, and seakeeping. The basic equations of motion for a maneuvering ship and for ship motions in a seaway are developed, and various methods of solution are discussed. Prereq: EN352; coreq: EN 459.

EN454 Ship Vibrations (3–0–3). A ship is complex elastic structure in which vibration may be caused by periodic forces generated by waves, propellers, or machinery. The basic concepts of vibration, as well as hull-, propeller-, and machinery-induced vibrations, are considered. Prereq: EM232.

EN456 Computer Applications in Naval Architecture (3–0–3). An introduction to computer-aided ship design is presented. Topics include numerical procedures applied to form, stability, resistance, propulsion, motion, maneuvering, and strength. Prereq: EN352 or permission.

EN457 Hydrofoil and Propeller Theory (3–0–3). The analysis and design of hydrofoils and marine propellers are presented. Lifting line and lifting surface theories are applied to naval devices. Design and towing tank work supplements recitations. Not offered every year. Prereq: EN352 or permission.

EN458 Advanced Marine Vehicles (2–2–3). Modern watercraft discussed: planing boats, hydrofoil craft, ground-effect machines, and combatant and research submersibles. Analysis and design features are investigated experimentally in the towing tank when appropriate. Prereq: EN453.

EN459 Experimental Naval Architecture (0–4–2). This course covers the experimental aspects of marine vehicle resistance, propulsion, and seakeeping. Vehicle hydrodynamics as well as experimental methods, data acquisition systems, and technical report preparation are studied and used. Prereq: EN352; coreq: EN453.

EN460 Ocean Systems Engineering Design (1–4–3). Conceptual design of a marine system is accomplished by midshipmen teams. The realistic project format followed will involve proposal writing, project manager designation, progress reports, and preparation and design review by experts. Prereq: 1/C standing, with an engineering major.

EN463 Reactor Physics II (2–2–3). The topics covered include neutron generation times, reactor period, delayed neutrons, negative temperature coefficient, xenon poisoning, control rod theory, shielding and, finally, a reactor kinetics case problem. Prereq: EN362.

EN464 Reactor Control Analysis (3–0–3). Reactor kinetics control theory and the feedback effects. Laplace transforms are used in the analysis of the input/output for a reactor. Prereq: EN463 or permission.

EN465 Advanced Marine Power Systems (3–0–3). A preliminary design of naval powerplants. Through use of a case problem, the student learns to synthesize a large number of machinery elements into a functioning system to give the desired performance. Prereq: EM324, EN361.

EN466 Nuclear Energy Conversion (3–0–3). Principles of the conversion of nuclear energy into useful power are covered. Various types of nuclear power plants, their design, cycles, load following characteristics, etc. are studied. Direct nuclear energy conversion systems are also studied. Prereq: EN362.

EN470 Life Support Systems (3–0–3). The physiological and psychological aspects of “man in the sea” are presented with their related engineering requirements. Topics include hyperbaric physiology, saturation diving, life support equipment, deep dive systems, diving operations and hazards. Prereq: 1/C Engineering major or permission.

EN473 Ocean Engineering Mechanics (2–2–3). Effects of gravity waves on surfaced and submerged floating bodies and on moored and fixed bodies. Measurement techniques discussed include measurements of wave height, wave-induced forces, and motions in waves. Prereq: EM324, EN241 or permission.

EN474 Ocean Energy Conversion (3–0–3). Covers five ocean energy sources: ocean thermal gradients, wind waves, tides, ocean currents, and salinity gradients. Each source is discussed in terms of the
nature of the resource, the conversion technology, and the environmental consequences of the energy conversion. The potential of each source is compared to those energy sources being presently exploited. Prereq: EM318 or EM324.

EN477 Undersea Power System (3-0-3). The principles of design of undersea power systems are presented. Topics include batteries, fuel cells, chemical-dynamic systems, radioisotopes and nuclear reactor systems, and cable systems. Not offered every year. Prereq: EE332, EM324, EN241 or permission.

Department of Weapons and Systems Engineering

Systems Engineering Major

This interdisciplinary major is accredited by ABET and encompasses such diverse fields as electronics, fluids, linear physical systems, automatic control systems, digital computer technology, and system simulation using analog, digital, and hybrid computing systems. An overall understanding of the analysis and design of complete engineering systems, including the various interfaces present, is the primary goal. A Bachelor of Science in Systems Engineering is awarded.

Curriculum Requirements (In addition to the requirements of plebe year)
Professional: NN203, NS252, NL200, ES300, NN302, NL303, NS300,* NL400;
Mathematics: SM211, SM212, SM239;
Science: SP211, SP212;
Humanities/Social Sciences: HE300* and FE210 plus three electives;
Language: none;
Special: EM231, EM232, EM318, EM319, EM331, EE332;
Major: ES201, ES303, ES305, ES306, ES309, ES402, ES416, plus five approved electives;
Restricted elective: one.
* Taken during second class summer

Systems Engineering Courses

ES201 Introduction to Systems Engineering (2-2-3). Introduction to the modeling and control of electrical, mechanical, and hydraulic systems. A survey of the simulation and control laboratory courses available in Systems Engineering. Prereq: SI100; Coreq: SM212.


ES305 Linear Control Systems I (3-0-3). A study of dynamic behavior of physical systems through classical transform and modern state variable techniques. Prereq: ES201; Coreq: ES303.


ES309 Linear Control Systems II (3-0-3). Analysis and design of linear automatic control systems. Prereq: ES301, ES305; Coreq: ES306.

ES400 Weapons Systems Engineering (3-2-4). A study of the engineering principles governing the
“Ours is a maritime nation, requiring the most powerful navies to protect our free rights to the farthest reaches of the seas.”

PRESIDENT
LYNDON B. JOHNSON

functioning of the various components (detection, control, delivery, and destruction) of naval weapons systems. Prereq: ES300, 1/C At-Sea Training, EN300, EE312

ES402 Systems Engineering Design (2-4-4). Introduction to the macro-techniques of engineering design including performance, reliability, management control, redundancy, man-machine systems, and testing techniques. Design, construction, test, and evaluation of an approved project is accomplished in the lab. Prereq: ES306, ES309.


ES407 Hybrid Computer Computation (1-4-3). Introduction to hybrid computation, hardware and software consideration of hybrid interface, digital filter and controller simulations, and solution of boundary value and optimization problems using hybrid techniques. Prereq: ES306 or consent of instructor.


ES410 Control Systems and Their Application to Weapons (3-2-4). Linear control systems for engineering majors, using analytical, graphical, and computer techniques. Prereq: 1/C standing in an engineering major or approval of department chairman.

ES412 Digital Information Systems (3-0-3). Analysis of digital information and its transfer through communication systems. Prereq: 1/C standing in an engineering major or approval of department chairman.


ES416 Advanced Control Systems (3-0-3). A study of advanced topics of automatic control systems including compensation, modern control theory, and nonlinear analysis, and selected topics in research techniques. Prereq: ES305, ES309.

ES442 Microcomputers in Control Applications (2-2-3). An introduction to the role of the microcomputer as a component in control systems, applying assembly language programming techniques and a variety of interface hardware. Prereq: ES408.
Division of Mathematics and Science

Department of Applied Science
Department of Mathematics
Department of Chemistry
Department of Oceanography
Department of Physics

Department of Applied Science

Applied Science Major

The major in Applied Science provides the option of three academic concentrations: computer science, management, or operations analysis. After three semesters, each midshipman chooses one of three concentrations to pursue in the remaining three semesters. An undesignated Bachelor of Science degree is awarded.

Curriculum Requirements (In addition to the requirement of plebe year)
Professional: NN203, NL200, EN200, NS252, NS300, NL303, NN302, EN300, ES300, EE311–312, ES400, NL400;
Mathematics: SM201 or SM211, SM202 or SM212;
Science: SP201, SP202, and one science elective;
Humanities/Social Sciences: HE300, FE210, one economics elective plus two other electives;
Language: None;
Applied Science Major (Common): SR201, SA302, SI304, SM219 or SM239; Management concentration: SR202, SR301, EM221, EM327, EN201, and three major electives; Operations Analysis concentration: SA401, SA441, SM261, and five major electives; Computer Science concentration: SI211, SI301, SI302, SI412, SI421, SI431, SM264, and one major elective.

Management Courses

SR201 Fundamentals of Resources Management (3–6–3). This introductory course complements the science portion of the major with specific administrative procedures and approaches required to ensure economical and efficient use of men, money, and materials.
SR202 Accounting (3–0–3). An introductory course in the basic principles of accounting.
SR401 Material Management (3–0–3). Examines concepts of integrated logistics and life cycle support, requirements determination, procurement and contract administration and inventory control, with primary emphasis on quantitative techniques. Prereq: SR201, SR202.
SR402 Management Information Systems (3–0–3). Professional applications of military computerized...
John Paul Jones, a Gentleman as well as a Seaman, both in Sense Strong and well-connected Theory and in Practice.

"A Captain of the Navy ought to be a man of Strong and well-connected Sense with a tolerable education, a Gentleman as well as a Seaman, both in Theory and in Practice."

John Paul Jones

Operations Analysis Courses

SA302 Analysis of Naval Tactics (3–2–4). An introduction to the techniques of modeling and quantitative analysis applied to specific naval operational problems, including search and patrol, screening, anti-air warfare, mining, equipment reliability and decision rules. Prereq: SM239 or SM219.


SA402 Methods of Operations Analysis II (3–0–3). Investigation of quantitative analysis of decision options including PERT/CPM, dynamic programming, Markov chains, and queuing theory. Applications to typical operations are stressed. Prereq: SM219 and SM261.


SA412 Applications of Operations Analysis (2–2–3). Operations research techniques are applied using student projects, case studies and visiting lecturers to relate the applications of operations analysis techniques to current military and industrial problems. Prereq: permission of manager of study group.

SA430 Logistics (3–0–3). Investigates those techniques of operations analysis applicable to the solution of problems in reliability, maintainability, availability, and inventory. Prereq: SM239 and SA302 or SA401.

SA441 Applied Statistics I (3–0–3). An applied study of a variety of statistical methods used in obtaining, presenting, summarizing and analyzing statistical information. Included are strategies for data collection and presentation, and techniques of statistical inference for population parameters based on the concepts of sampling, probability, and distribution theory. Prereq: SM239.

SA442 Applied Statistics II (3–0–3). A continuation of SA441 that includes examination, evaluation, and application of advanced statistical methods. Techniques studied include sampling, nonparametric analysis, simple and multiple regression, correlation, analysis of variance, and decision theory. Prereq: SA441.

Computer Science Courses

SI100 Introduction to Computing (2–0–2). A first course in computer science for students in all majors. Programming in the BASIC language including techniques for arrays, character manipulation, file handling, and subprograms.


SI301 Data Structures (3–0–3). Data representation and information management. Lists, strings, arrays, trees, graphs. Storage structures, allocation, and collection. Sorting techniques, symbol tables, and searching. Prereq: SI211.


SI304 Programming Languages (3–0–3). Functional and technical characteristics of algorithmic, problem-oriented, list processing, string manipulating, and simulation languages. Survey of important programming languages. Prereq: SI100.

SI305 Applied Algorithmic Processes (3–0–3). This course presents a top-down design approach to the development of structured algorithms for computer problem solving. Programs which implement these
concepts are to be written in a high-level structured language such as FORTRAN. Prereq: SI100 or SM162, and SM201 or SM211.


Department of Mathematics

Mathematics Major

The major in Mathematics provides students with the opportunity to acquire a sound mathematical foundation and to develop facility in applying mathematical concepts and techniques. The program permits a concentration in mathematics, computer science, or operations analysis plus a choice of electives in physics and engineering. A solid background in mathematics facilitates postgraduate specialization in many technical areas, including nuclear power. An undesignated Bachelor of Science degree is awarded.

Curriculum Requirements (In addition to the requirements of plebe year)
Professional: NN203, NL200, EN200, NS252, NS300, NL303, NN302, EN300, ES300, EE311–312, ES400, NL400;
Mathematics: SM201 or SM211 or SM251, SM212, SM239, SM261, SM331, SM332;
Science, SP211, SP212, and one science/engineering elective;
Humanities/Social Sciences: HE300* and four electives;
Language: none;
Special: one free elective;
Mathematics concentration: SM262, two SM4 courses, plus two area electives;
Operations Analysis concentration: SA302, SA401, SA441, plus two area electives;
Computer Science concentration: SI211, SI301, SI302, plus two area electives.
* Taken during second class summer

Physical Science Major

The major in Physical Science provides students with the opportunity to pursue a broad scientifically oriented program in the field of physical applications of mathematics and science. The major permits midshipmen to experience an inter-disciplinary technical course without the need for specialization. An undesignated Bachelor of Science degree is awarded.

Curriculum Requirements (In addition to the requirements of plebe year)
Professional: NN203, NL200, EN200, NS252, NS300,* NL303, NN302, EN300, ES300, EE311–312, ES400, NL400;

"... took me a whole semester to learn how to study. Calculus and chemistry are hardest."
Mathematics Courses

SM005 Pre-Calculus Mathematics (4-0-4). Basic review of algebraic and arithmetic operations, analysis of functions and their graphs, trigonometry. This course does not fulfill any of the mathematics requirements of any major and may, in addition, be required above stated graduation requirements for certain midshipmen. Prereq: permission of department chairman.

SM101 & SM102 Introduction to Analytic Geometry and Calculus I & II (4-0-4, 4-0-4). Course content similar to SM111 and SM112. For those not qualified to enroll in SM111.

SM101T Introduction to Analytic Geometry and Calculus I with Trigonometry (5-0-5). Same as SM101 plus trigonometry.

SM111 & SM112 Calculus and Analytic Geometry I & II (4-0-4, 4-0-4). Plane analytic geometry; differential and integral calculus of one real variable.

SM161 & SM162 Calculus with Computers I & II (3-0-3, 3-0-3). Programming using BASIC, algorithmic development of the integral and differential calculus of one real variable. Prereq: permission of department chairman.

SM201 Analytic Geometry and Calculus III (4-0-4). Course content same as SM211 plus material to strengthen the background of students completing SM102. Prereq: SM102 or permission of department chairman.

SM202 Elements of Differential Equations (3-0-3). Course content same as SM212 except for material on the Laplace transform. Prereq: SM201, SM211 or SM251.

SM211 Calculus and Analytic Geometry III (3-0-3). Solid analytic geometry, series, partial differentiation, and multiple integration. Prereq: SM112 or SM162.

SM212 Differential Equations (4-0-4). Linear and simultaneous differential equations; solution by Laplace transform and series; partial differential equations and Fourier series. Prereq: SM201 or SM211 or SM251.

SM219 Probability and Statistics (3-0-3). Nature of statistical methods, description of data, probability, distributions, sampling, estimation, testing hypothesis, correlation and regression. Computer methods emphasized. Credit cannot be given for SM219 if credit has been given for SM239. Prereq: SM102 or SM112 or SM162; SI100 or equivalent.

SM230 Introduction to Probability and Statistics (3-0-3). An elementary treatment of the basic concepts of probability models and statistical inference. Sample spaces, discrete and continuous random variables, central limit theorem, sampling, estimation, hypothesis testing. Credit cannot be given for SM230 if credit has been given for SM239. Prereq: SM102 or SM112 or SM162.


SM251 Calculus with Computers III (4-0-4). Course content includes and extends that of SM211 with extensive computer applications. Prereq: SM162.

SM259 Mathematical Logic (3-0-3). Mathematical languages, formal logic, propositional calculus and truth tables, first order predicate calculus, proof theory, axiomatic systems and model theory. Prereq: SM102 or SM112 or SM162.

SM261 Matrix Theory (3-0-3). Matrices, transformations, linear equations, vector spaces, characteristic matrix, eigenvalues, orthogonality. Prereq: SM102 or SM112 or SM162.

SM262 Modern Algebra (3-0-3). Integers, groups, mappings, rings, fields. Prereq: SM102 or SM112 or SM162.

SM264 Introduction to Numerical Analysis (3-0-3). Polynomial approximations, iterative methods for solving equations, systems of linear equations, numerical integration, interpolation, curve fitting. Computer methods emphasized. Prereq: SM102 or SM112 or SM162; SI100 or equivalent.

SM269 Probability and Statistics II (3-0-3). Estimation, confidence intervals, tests of hypothesis,
Bayesian methods, least squares, regression. Prereq: SM239.


SM271 Linear Programming (3–0–3). Simplex and dual simplex methods, minimax theorem, integer and parametric programming, transportation problems, and game theory. Prereq: SM261 or permission of instructor; SI00 or equivalent.

SM281 Vector Analysis (3–0–3). Vectors, vector calculus and fields, line and surface integrals, Stokes and Gauss' theorems. Prereq: SM201 or SM211 or SM251.


SM312 Engineering Mathematics II (3–0–3). Laplace and Fourier transforms, selected topics from complex variables. Prereq: SM212.


SM331 Advanced Calculus I (4–0–4). Set theory, real number systems, Euclidean spaces, topological concepts, compact and connected sets, continuous mappings, uniform convergence. Prereq: SM261.

SM332 Advanced Calculus II (4–0–4). Differentiation, mean value theorem, Taylor's theorem, inverse and implicit function theorems, extremal problems with and without constraints, integration, multiple integrals. Prereq: SM331.

SM411 Introduction to Complex Variables (3–0–3). Number field, Cauchy-Riemann differential equations, analytic functions, series, singularities, residues, conformal mapping, and continuation. Prereq: SM331.

SM425 Advanced Numerical Analysis (3–0–3). Numerical solution of equations in one and several variables, direct and iterative algorithms, rate of convergence. Computer methods emphasized. Prereq: SM331 or permission of instructor.

SM426 Numerical Methods for Differential Equations (3–0–3). Interpolation and polynomial approximation, numerical integration and differentiation, numerical algorithms for initial value and boundary value problems. Prereq: SM212, SM331 or permission of instructor.

SM433 Methods of Applied Mathematics (3–0–3). A course in mathematical methods applicable to problems in physics, engineering, control theory, and operation analysis. Linear spaces, calculus of variations and integral equations. Prereq: SM331 or permission of department chairman.


SM462 Algebraic Structures (3–0–3). Groups, rings, fields, Galois theory. Prereq: SM262. SM331.


SM468 Measure and Integration (3–0–3) Construction, properties and extensions of measures, Lebesgue-Stieltjes measures, integrals, Fubini and Nikodym theorems, Daniell integral, relation to probability theory. Prereq: SM332.

Department of Chemistry

Chemistry Major

Chemistry, an experimental science, is the most laboratory-oriented program offered at the Naval Academy. The laboratory facilities of Michelson Hall are unexcelled at the undergraduate level. Serious students of chemistry have ample opportunity to experiment and observe as they pursue the scientific method. Laboratory equipment includes single-pan balances, gas chromatographs, a mass spectrometer, X-ray diffraction equipment, and nuclear magnetic resonance spectrometers.

Any naval officer will profit from a good knowledge of chemistry. A background in the fundamental principles of chemistry and modern experimental techniques is

"All that mankind has done, thought, gained or been: it is lying as in magic preservation in the pages of books." THOMAS CARLYLE
highly valuable for officers working in such technical subspecialties as oceanspace research, life sciences and support systems, propellants, and many others. The Chemistry major is accredited by the American Chemical Society. An undesignated Bachelor of Science degree is awarded.

**Curriculum Requirements** (In addition to the requirements of plebe year)

Professional: NN203, NL200, EN200, NS252, NS300,* NL303, NN302, EN300, ES300, EE311-312, ES400, NL400;

Mathematics: SM211, SM212;

Science: SP211, SP212;

Humanities/Social Sciences HE300* and four electives;

Language: none;

Special: two free electives;

Major: SC201, SC202, SC301, SC302, SC304, SC321, SC322, SC401L, SC402L, and two nonspecified chemistry electives;

Restricted elective: one.

* Taken during second class summer

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**Chemistry Courses**

**SC103 & SC104 Elements of Chemistry (3-2-4, 3-2-4).** A two-semester sequence presenting the fundamental laws and theories of chemistry. Atomic and molecular structures, periodicity, chemical equilibrium, kinetics, and electrochemistry are covered in a balanced classroom and laboratory development for the student with a limited chemistry, mathematics, and science background.

**SC105 & SC106 General Chemistry (3-2-4, 3-2-4).** A two-semester sequence stressing the fundamental laws and theories of chemistry. Topics include atomic and molecular structures, bonding, chemical thermodynamics, equilibrium, kinetics, acids and bases, and electrochemistry. Laboratory emphasis is on development of scientific laboratory skills, particularly the generation, analysis and presentation of data. **Prereq:** one year of high school chemistry.

**SC113 & SC114 Principles of Chemistry (3-2-4, 3-2-4).** A rigorous course in the fundamental principles underlying the areas of inorganic, organic, and physical chemistry designed for students with above average aptitude and ability in the sciences. **Prereq:** one year of high school chemistry.

**SC201 & SC202 Organic Chemistry (3-6-5, 3-6-5).** The chemistry of covalent compounds of carbon, including aromatic, aliphatic, and heterocyclic. The second semester laboratory includes qualitative organic analysis. Special attention is given areas of petroleum, plastics, drugs, and spectroscopy. **Prereq:** SC114, SC106, or SC104.

**SB251 General Biology I (3-2-4).** Fundamental principles are introduced. Topics include protoplasm, plant and animal histology, plant and animal metabolism, gametogenesis, and cell division, as well as genetics, ecology, and organic evolution.

**SB252 General Biology II (3-2-4).** Expands upon topics from General Biology I, particularly plant and animal metabolism, and introduces vertebrate morphology and physiology.

**SC301 & SC302 Physical Chemistry (3-0-3, 3-0-3).** An introduction to the physical states of matter, kinetic theory of gases and liquids, thermodynamics, phase equilibria, properties of solutions, atomic and molecular structure. **Prereq:** SM211, SP212.

**SC304 Instrumental Methods of Analysis (2-6-4).** The theory and applications of modern instrumental methods of analysis are stressed. A wide array of sophisticated instruments is available for student use. **Prereq:** SC301, SC321.

**SC321 Quantitative Analysis (2-6-4).** A study of volumetric, gravimetric, and modern optical and electrical methods of analysis. Theory and laboratory procedures and techniques are stressed. **Prereq:** SC104 or SC106.

**SC322 Inorganic Chemistry I (3-0-3).** An in-depth study of fundamental concepts including topics in atomic structure, chemical bonding and coordination chemistry. **Prereq:** SC302.

**SC401L & SC402L Physical Chemistry Laboratory (0-3-1, 0-3-1).** A comprehensive, sophisticated laboratory course designed to give practical laboratory experience in the areas covered in courses SC301 and SC302. **Prereq:** SC301, SC321.

**SC432 Biochemistry (3-0-3).** The biological chemistry of the human body is discussed, including both normal and abnormal aspects. Metabolism, nutrition, vitamins, and hormones are included. **Prereq:** SC201.
Department of Oceanography

Oceanography Major

Oceanography is an inter-disciplinary science major involving the study of meteorology, geophysics, physics, chemistry, biology, and geology as they relate to our ocean environment and the effects of that environment on naval operations. It is a laboratory-oriented program with the most modern facilities, including an oceanographic research vessel, a field laboratory, a weather station and radiosonde system for study of the atmosphere, plus a wave tank, a rotating tank, demonstration tank, atmospheric chamber, tide gauges, marine culture systems, and fully equipped laboratories. An undesignated Bachelor of Science degree is awarded.

Curriculum Requirements (In addition to the requirements of plebe year)
Professional: NN203, NL200, EN200, NS252, NS300,* NL303, NN300, ES300, EE311–312, ES400, NL400;
Mathematics: SM201 or SM211, SM212, SM219, SM311;
Science: SP211, SP212;
Humanities/Social Sciences: HE300* and four electives;
Language: none;
Special: none;
Major: SB251, SO261, SO313, SP328, SO341, SO413, SO424, SO482, and SP411 plus two approved major electives;
Restricted elective: one.
* Taken during second class summer

Oceanography Courses

SO211 Introductory Oceanography (3–0–3). An introductory course designed for Physical Science majors treating: physical and chemical properties of sea water, submarine geology, marine biology, the heat budget of the oceans, water masses and general circulation, currents, waves, and tides. Prereq: SCI04, SCI106 or SCI114; SP202.

SO221 Introduction to Oceanography (3–0–3). A descriptive course designed for the Ocean Engineering major to provide an overview of significant oceanographic factors and their impact on engineering applications. Prereq: SCI104, SCI106 or SCI114; SP201 or SP211; SM201 or SM211.

SO261 Physical Geology (3–2–4). A study of the dynamic Earth, centered around the concept of global plate tectonics, with emphasis on the materials, form and structure, and particularly the internal and external processes which shape the Earth and affect its inhabitants.

SO313 General Oceanography (3–2–4). Beginning physical oceanography, the ocean basins, age and origin of oceans, physical properties of sea water, chemical properties of water and ice, distribution of variables, and physical characteristics of estuaries. Ocean current systems, water masses, motion producing forces, heat budget, heat distribution and thermal structure, waves, tides, and marine biology. Laboratory work includes a field trip and oceanographic surveys of Chesapeake Bay. Prereq: SB251, SO261, SCI106 or SCI114, SP212, SM201 or SM211.

SO341 General Meteorology (3–0–3). An introductory study of the atmosphere including: radiation, weather patterns and phenomena, atmospheric motion, and the effects of weather on naval operations. Prereq: SM201 or SM211; SP201 or SP211.

SO412 Environmental Instruments (2–2–3). A study of theoretical and practical characteristics of instruments used in collecting oceanographic and meteorological data. Prereq: SO313, SO221 or SO211; SO341.

SO413 Oceanic and Atmospheric Processes (3–0–3). The dynamics of quasi-horizontal, inviscid flow on the rotating earth. The motions of interest are isolated through the use of scale analysis of the governing equations. Prereq: SP328; SO313, SO221 or SO211; SO341.

"For they had learned that true safety was to be found in long previous training, and not in eloquent exhortations uttered when they were going into action."

THUCYDIDES
"To insure safety at sea, the best that science can devise and that naval organization can provide must be regarded only as an aid, and never as a substitute for good seamanship, self-reliance, and sense of ultimate responsibility which are the first requisites in a seaman and naval officer."

ADMIRAL CHESTER W. NIMITZ

SO415 Environmental Pollution (2-2-3). Concerns environmental problems involving air and water. Topics include pollution sources and control, hydrology, solid wastes, recycling, noise, and legal aspects. Laboratory work includes field trips and pollution surveys. Prereq: SO313, SO221 or SO231; SO341.

SO422 Nearshore Oceanography (2-2-3). Examines the oceanographic regime from the continental break to the intertidal zone, concentrating on shallow water wave, surf, and beach processes. Prereq: SO313, SO221 or SO211.

SO424 Waves and Tides (3-0-3). The dynamics of surface and internal wave phenomena in the oceans and atmosphere and an examination of wind-generated wave characteristics and prediction methods. Prereq: SO413.

SO441 Synoptic Meteorology (2-2-3). A practical course in meteorological analysis and forecasting as applied to operational planning. Prereq: SO341.

SO442 Tropical Meteorology (2-2-3). A study of the special processes affecting meteorological analysis and forecasting in the tropics with particular emphasis on hurricane/typhoon prediction, creation, movement, and decay. Not offered every year. Prereq: SO441.

SO444 Climatology (3-0-3). A climatic approach to weather phenomena. Prereq: SO341; SM219 or SM239; SO313, SO221 or SO231.

SO451 Biological Oceanography (2-2-3). An introduction to the ocean as a biological environment. Laboratory work includes practical studies of the biology of the Chesapeake Bay. Prereq: SB221; SO313, SO221 or SO211.

SO461 Geological Oceanography (2-2-3). Introduction to marine geological instrumentation, theory and data gathering, analysis, interpretation and applications. Geomorphology, structure, petrology, sedimentation, stratigraphy, origin and development of ocean basins and margins are examined in light of theory of plate tectonics. Practical studies of the Chesapeake Bay are part of the laboratory work. Prereq: SO261; SO313, SO221 or SO211.

SO463 Current Topics in Oceanography and Meteorology (3-0-3). Provides an opportunity to present current material pertinent to oceanography and meteorology and their application to areas of Navy interest. Not offered every year. Prereq: SO313; SO441.

SO471** Chemical Oceanography (2-2-3). The modern approach to the ocean as a chemical system. Laboratory instruction emphasizes principles with appropriate methods. Classical concepts are discussed, as well as newer trends. Prereq: SO313, SO221 or SO211.
Department of Physics

Physics Major

The major program in Physics: (1) presents fundamental physical concepts and principles in such a way as to emphasize their general usefulness and (2) lays a strong foundation for further work in a broad range of technical fields. Some of the topics treated in the sequence of courses are the origin, propagation, and reception of waves of all kinds; field concepts; theory of relativity; basic theory of quantum mechanics; and statistical mechanics. All are studied with the object of providing an open-minded and creative approach to the physical world—an approach increasingly important to those who will be leaders in our modern Navy. A solid background in physics achieved at the Academy will facilitate subsequent specialization in any technical area. An undesignated Bachelor of Science degree is awarded.

Curriculum Requirements (In addition to the requirements of plebe year)
Professional: NN203, NL200, EN200, NS252, NS300,* NL303, NN302, EN300, ES300, EE331–332, ES400, NL400;
Mathematics: SM211, SM212, SM311;
Humanities/Social Sciences: HE300* and four elective courses;
Language: none;
Special: none;
Major: SP221, SP222, SP226, SP324, SP331, SP332, SP341, SP425, SP444, plus two physics electives and one elective from engineering, science, or mathematics;
Restricted elective: one.
* Taken during second class summer

Physics Courses

SP201 & SP202 Basic Physics I & II (3–2–4, 3–2–4). Introduces the basic concepts of kinematics, dynamics, heat & thermo-dynamics, wave motion, sound, optics, electricity, and magnetism. Prereq: SM101 for SP201; SP201 for SP202.

SP211 & SP212 General Physics I & II (3–2–4, 3–2–4). Emphasizes the fundamental principles of classical physics; however, contemporary applications are introduced as appropriate. The topics covered are mechanics, electricity, magnetism, wave motion, thermodynamics, sound, and light. Prereq: Calc. I for SP211; SP211 for SP212.

SP221 Physical Mechanics I (3–2–4). The first course in physics for majors in physics. This course provides the basic classical mechanics for further study in physics. Prereq: SM111 or approval of department chairman.

SP222 Electricity and Magnetism I (3–2–4). A first course in electricity and magnetism with emphasis on the concepts of fields and potential. The course culminates in the formulation of Maxwell's equations. Prereq: SF221 or SP221.

SP226 Heat, Sound and Light (3–2–4). Develops the basic concepts in heat, sound and light. The coherency of the basic concepts in physics is emphasized. Prereq: SP221.

SP301 Modern Physics (3–0–3). An introduction to relativistic mechanics and the particle aspects of electromagnetic radiation. Emphasis on the decay of unstable nuclei and nuclear reactions. Prereq: SP202 or SP212 or SP226.

SP310 Astronomy (3–0–3). The fundamentals of astronomy as a physical and mathematical science, covering the solar system, stellar and galactic astronomy, and cosmology. Prereq: SP202 or SP212 or SP226.

SP324 Physics of the Atom I (3–2–4). A first course in atomic and nuclear physics for majors in physics. Topics covered are black body radiation, photon theory of radiation, development of Rutherford and Bohr atoms, wave properties of matter, the Schrödinger wave equation, and quantum theory of hydrogenic atoms. Prereq: SP331, SM212, Coreq: SM311 or permission of the instructor.
"The best opportunity at Annapolis is to learn to work with people."

SP328 Fluid Physics (3--0--3). A first course in classical fluid mechanics which addresses the fundamentals of inviscid, incompressible flow dynamics, circulation, vorticity, and turbulent flow. Prereq: SP212, SM311, SC3013 or permission of department chairman.

SP331 Physical Mechanics II (4--0--4). A first course in physical mechanics at the intermediate level. Newtonian and Lagrangian mechanics with special emphasis on oscillating systems, the central force problem, and non-inertial reference frames. Prereq: SP221 or SP212, SM221.

SP332 Physical Mechanics III (3--0--3). A continuation of Physical Mechanics II, with emphasis on special relativity, the mechanics of both rigid and deformable bodies, and an introduction to variational principles. Prereq: SP331.

SP341 Electricity and Magnetism II (3--0--3). A course in electromagnetic theory required for all majors in physics and electrical engineering. Maxwell's equations are formulated in the notation of vector analysis and applied to various situations. Prereq: SP222 and SM311.

SP411 Underwater Acoustics and Sonar (3--0--3). A fundamental study of sound propagation in the ocean environment as it relates to the design and operation of sonar. Prereq: SP202 or SP212 or SP226.


SP434 Nuclear Physics (3--2--4). A study of the basic static and dynamic properties of the nucleus and of the interaction of particles and radiation with matter with emphasis on the experimental techniques. Where appropriate, quantum mechanical interpretations of the phenomena are given. Prereq: SP425.

SP436 Acoustics (3--2--4). An introduction to modern acoustics. The topics included are normal modes and boundary value problems, discrete Fourier transform, radiation, transmission and detection of sound waves, electro-acoustics, psycho-acoustics, architectural acoustics, and underwater acoustics. Prereq: SP211 or SP221 and SM221.

SP438 Optics (3--2--4). Introduction to modern optics including the use of Fourier transforms in the study of diffraction, the concepts of partial coherence, interference theory, holography, polarization, and the optics of solids. Prereq: SP431.

SP440 Solid State Physics (3--0--3). An introductory course in physics of the solid state. The topics included are crystal structures, thermal properties, free electron model, band theory, magnetism resonance, and semiconductors. Prereq: SP224.

SP444 Thermal Physics (3--0--3). A presentation of classical thermodynamics followed by kinetic theory and statistical thermodynamics. Prereq: SP425 or permission of the department chairman.

SP445 Stellar Astrophysics (3--0--3). A study of the basic physics of stellar properties or processes: mass, luminosity, stellar spectra, chemical composition, stellar energy sources, nucleosynthesis, stellar models and stellar evolution. Prereq: SM221, SP301 or SP324, SM310 or permission of instructor.
English Major

The major program in English offers study of the most significant and influential writings of civilization from ancient times to the present, as well as the opportunity for independent study and for creative writing projects. A special feature of the program is that the literature of virtually all major countries and cultures is considered, in contrast to traditional offerings which are normally restricted to British and American literature. An undesignated Bachelor of Science degree is awarded.

Curriculum Requirements (In addition to the requirements of plebe year)

Professional: NN203, NL200, EN200, NS252, NS300, *NL303, NN302, EN300, ES300, EE311-312, ES400, NL400;
Mathematics: SM211, SM212;
Science: SP201, SP202;
Humanities/Social Sciences: HE300* and two elective courses;
Language: Four semesters of a modern language;
Special: none;
Major: HE333, HE442 plus eight approved major electives;
Restricted elective: one.

* Taken during second class summer
** Not offered every year

English Courses

HE101 Practical Writing (2-0-2). The study and practice of grammatically correct and rhetorically effective expository prose, supplemented by the analysis of essays by professional writers. For students selected by English Department.

HE111-112 Rhetoric and Introduction to Literature I & II (3-0-3, 3-0-3). Stresses the writing of rhetorically effective and grammatically correct expository prose. During the first semester, students read essays, short stories and plays, and they write brief essays (up to 500 words) and a research exercise or paper. During the second semester, students read novels and poetry, and write longer essays.

200-Level Courses: General Description

The literary content of courses on this level is eclectic. These courses offer wide surveys of materials from different cultures, historical periods, literary types and issues. In each course, substantial practice in writing is to be expected; if a term paper is required, prior to the submission of such a paper there will also be several essays or written exercises to test and evaluate the student’s writing competence. No pre-requisites for any course in the 200 group; they may be taken at any class level, including the fourth class year.

HE219 The Literature of Classical and Christian...
Ideas (3–0–3). The foundations of modern literature in the literature of classical Greece and Rome and medieval Europe. Readings in mythology, philosophy, the epic, drama, and poetry. Attention will be given to the traditions, ideas, and conventions which have shaped the development of Western literature.

HE222 The Bible and Literature (3–0–3). Studies in the Bible and its influence on European and American literature. Emphasis will be placed on modern Biblical literary-critical methodology and in the symbolic richness of derivative literature from Dante to Bernard Malamud.

HE223 Modern World Literature (3–0–3). Readings in the literature of contemporary cultures throughout the world, notably in the twentieth-century literatures of South America, Africa, Japan, and the Near East, as well as of the United States and Europe. The literature of the current world scene as it will be experienced by the modern professional officer.

HE224 Literature and Science (3–0–3). The interrelationships among science, technology, and literature since the Renaissance. The impact of science on literature and the implications of science as reflected in literary responses.

HE231 Literature of American Minorities (3–0–3). The culture and concerns of American minorities (Afro-American, Native American, Hispanic, Asian-American, etc.) as reflected in modern literature.

HE240 American Black Literature (3–0–3). Provides a generic survey of representative American black literature. Major figures including Toomer, Hughes, Wright, Ellison, Baldwin, Baraka, Brooks, Hayden and Morrison are stressed as the genres of short fiction, poetry, drama and the novel are covered.

HE250 Literature of the Sea (3–0–3). Study of the principal genres of the literature of the sea (an epic, novels, shorter fiction, and poetry). Emphasis on literary qualities, man's relationship with the sea, and problems of command.

HE260 Introduction to Mass Communications (3–0–3). An introduction to the nature of mass communications and their audiences. The effects of mass communication on the individual and society. The historical development of mass communication. The future of mass media.

300-Level Courses: General Description

These courses build on the foundations of literary analysis, comprehension, and writing acquired in HE11–112. The HE301–306 series goes more deeply into each of the basic literary types; the HE313–333 series approaches literature in its historical-cultural dimension while focusing on a limited historical period; the HE343–344 series offers extensive practice in a variety of writing forms. All courses, however, have a writing requirement intended to further the student's opportunity to improve skills. Prerequisites for all 300-level courses are HE11–112.

HE300 Public Communication (1–0–1). Indoctrination in the junior officer's role in the Navy's public affairs program. Practice in speaking in various situations. Taken during 2/C summer.

HE301 Patterns in Drama (3–0–3). Reading, viewing and analysis in a variety of dramatic experiences for the purpose of exploring the relationships among language, action, and form.

HE302 Forms of Poetry (3–0–3). An examination of the variety of techniques by which language is shaped into poetry. The focus is on analytic methods for understanding poetry.

HE306 Types of Fiction (3–0–3). Ideas and issues of modern fiction, with particular emphasis on the conventions, techniques, forms and innovations of the novel and short story.

HE313 Chaucer and His Age (3–0–3). The literary and philosophical traditions within which Chaucer and his contemporaries worked. Readings in Chaucer's works, the Gawain poet, and others, including early and late medieval writers from England and the Continent. Not offered every year.

HE314 The Renaissance Mind (3–0–3). Literature and thought of the period bracketed by the two great English epics, Spenser's Faerie Queene and Milton's Paradise Lost. The course includes a continental perspective, with readings from such authors as Machiavelli, Rabelais, Cervantes, Montaigne, and Castiglione. Not offered every year.

HE315 Satire and Sensibility in the Age of Reason (3–0–3). The literature of the "enlightenment" (1660–1780). Reading in the prose and poetry of Dryden, Swift, Pope, Addison and Steele, Johnson and Boswell as well as selected novels and such continental writers as Voltaire. Not offered every year.

HE317 The Romantic Vision (3–0–3). Concentrates on how writers from 1798 to 1870 responded to the growth of industrialism, religious skepticism, nationalism, and a host of other problems associated with modern life. Readings in representatives of the Romantic and Victorian periods. Reading in such continental writers as Goethe and Novalis may be included. Not offered every year.

HE318 Modern British Literature (3–0–3). The literature of Great Britain and Ireland of the past hundred years. The novels of Hardy, Conrad, Joyce, Lawrence, Golding, and Lessing; the plays of Shaw, Synge, O'Casey, and Pinter; the poetry of Yeats, Eliot, Auden, and Dylan Thomas.

HE326 Literature of the American Dream, 1620–1860 (3–0–3). A survey of American literature from the time of the Pilgrims to the outbreak of the Civil War. Emphasis is on the relationship between the emerging culture and literature. Not offered every year.
HE328 America's Literary Coming of Age (1860-1920) (3-1-3). A study of American literature from the Civil War to the development of the United States as a major industrial and military political power after World War I. Focus of the course is the American writer's response to his own culture and to that of his broadening world. Not offered every year.

HE329 Modern American Literature: The 20th Century Challenge (3-0-3). A study of American literature from 1920 to the present with emphasis on the writers' interpretation of the complexities of 20th-century life.

HE333 Shakespeare and his Contemporaries (3-0-3). A study of Elizabethan and Jacobean ideas and attitudes through the investigation of a representative sample of Shakespeare's tragedies, histories, and comedies as well as a few plays by contemporaries of Shakespeare.

HE343 Creative Writing (3-0-3). After completing initial problem solving exercises in prose, poetry, and drama, students embark upon an approved workload of their own design. Criticism of students' work is accomplished through classroom workshops and individual conferences with instructor.

HE344 Professional Writing (3-0-3). Designed for students interested in advanced methods of preparing, writing, and presenting articles and reports. After initial study and analysis of the form and style in a wide variety of prose writing and practice in various prose forms, students will design and present independent projects. Not offered every year.

400-Level Courses: General Description

The HE460 series allows students and English Department faculty with special expertise to pursue together an intensive study of a restricted literary subject. Emphasis in each course will be upon extensive and intensive reading in a limited body of material, techniques of research, and the development of independent critical judgment. Prerequisites for these courses are at least one 300-level English course and permission of the instructor. Selection of students for HE470, Pedagogy in English, is made by the English Department from among 1/C English majors.

HE442 Introduction to Literary Criticism (3-0-3). The theory and practice of literary criticism. Concentrates on what critical approach can yield to the reader in the way of deeper understanding and satisfaction from the work of art. Offered each semester. Required of all English majors. Prereq: 1/C standing, or permission of English Department.


HE462 Studies in a Literary Problem (3-0-3). Cutting across traditional divisions of nationality, historical period, or genre, the materials of this course will be selected to focus on some timeless problem of literature and the human existence it reflects; for example: "Myth and Symbol in Literature," "Literature and Science," "The Concept of the Hero."

HE463 Studies in Literary Figures (3-0-3). Extensive reading in the works, biography, and criticism of major figures of world literature; for example: Milton, Wordsworth, Dickens, Joyce, D. H. Lawrence, Melville, Twain, Faulkner, Dostoyevsky, Thomas Mann. No more than three such writers will be considered in any one semester.


HE470 Pedagogy in English (3-0-3). Experience in leadership and in techniques of education and training through teaching a section of a 4/C writing tutorial under advisory supervision of a member of the staff of the Department of English. Limited to three 1/C English majors per semester.

Department of History

History Major

The major in History concentrates upon the development of the important civilizations, societies, and states of the world. The knowledge of historical evolution that is acquired will contribute significant perspective and maturity to the understanding of the great crises and confrontations of today's world and to a more acute awareness of the institutions and values at issue. The program provides a basic historical background as well as the opportunity for specialized study in the fields of American, European, non-Western, naval, and military history. An undesignated Bachelor of Science degree is awarded.

"I came here because I am serious about the business of learning."
"Correction does much but encouragement does more. Encouragement after censure is as the sun after a shower."

JOHANN GOETHE

"We give advice, but we cannot give the wisdom to profit from it."

LA ROCHEFOUCAULD

Curriculum Requirements (In addition to the requirements of plebe year)
Professional: NN203, NL200, EN200, NS252, NS300, * NL303, NN302, EN300, ES300, EE311–312, ES400, NL400;
Mathematics: SM211, SM212;
Science: SP201 and SP202;
Humanities/Social Sciences: HE300* and two elective courses;
Language: Four semesters of a modern language;
Special: none;
Major: HH241, HH262, HH223 or HH224, and seven history electives;
Restricted elective one.

* Taken during second class summer

History Courses

HH103 Modern Western Civilization Since 1715 (3–0–3). This course surveys Western civilization, focusing upon topical areas such as geography, and economical, social, political, and cultural developments. Within these topic contexts, special emphasis is given to the evolution of military institutions and policies.

HH104 American Naval Heritage (3–0–3). Building on the general background provided in the first semester, this course examines the antecedents, origins, and development of the United States Navy within the framework of America’s growth as a continental and, eventually, global power. Prereq: HH103.

HH105 The Western Cultural Heritage to 1815 (3–0–3). Analyzes patterns of human thought and action from ancient times to 1815. Adopting the premise that the cultural products of a people express the values and aspirations of its members, this course will approach the development of Western civilization to 1815 through a study of its ideas and institutions.

HH106 Civilization in the Atlantic Community Since 1776 (3–0–3). Pursues the study of human ideas and institutions from 1776 to the present—focusing primarily on the United States and Europe. As in the first semester, the course will seek to expose patterns of human thought and behavior in a cultural context.

HH223 History of the Ancient World (3–0–3). Surveys the foundations of Western civilization in the lands bordering on the Mediterranean. Begins with the Greek city states and continues to the fall of the Roman Empire.

HH224 History of Medieval and Early Modern Europe (3–0–3). Surveys the development of Western civilization from the fall of Rome through the Middle Ages and Renaissance and Reformation to the Age of Absolutism. It traces the development of the medieval synthesis, the rise of secular culture, commercial capitalism, and national government.

HH230 Introduction to Philosophy and Logic (3–0–3). A survey of Western secular philosophy based on readings in representative philosophers.
the basic problems of philosophical inquiry and a variety of solutions to them; principles of logic.

HH232 Ethics (3-0-3). A critical examination of systems of values and standards, with a discussion of current moral issues.

HH241 Survey of American History (3-0-3). A survey of American history from the discovery to the present, emphasizing the political, diplomatic, social, and economical developments that explain the nation's rise from settlement to superpower.

HH262 Perspectives on History (3-0-3). A methodology course in which History majors acquire the basic technical skills required for research and writing in subsequent courses in history and other humanities/social sciences disciplines. Prereq: History major, 3/C.

HH317 History of 19th Century Europe (3-0-3). A survey of European civilization from Napoleon through Bismarck. Traces social, economical, political, diplomatic, and cultural trends and developments, emphasizing the experience of the great powers.

HH318 History of 20th Century Europe (3-0-3). Recent European history, stressing the diplomatic relations of the era and the influence of ideologies of European politics and war.

HH321 Muscovite and Imperial Russia (3-0-3). A study of Russian history from the founding of Moscow to 1917, examining the domestic and external forces responsible for shaping the structure of Russian society and culture.

HH322 Soviet History and Contemporary Problems (3-0-3). An examination of the Revolution of 1917 and the development of the Soviet Union, emphasizing the institutions and policies adopted to meet domestic and foreign problems.

HH327 History of Recent Germany and East Central Europe (3-0-3). An analysis of the impact of Germany and the Soviet Union on East Central Europe since 1919, and the responses within the area to these predominating powers.

HH328 History of Britain (3-0-3). A survey of the political and cultural history of England, Scotland, and Ireland from 1485 to the present. Major topics covered include the Elizabethan Age, the Civil War and Glorious Revolution, the Industrial Revolution, the development of the British Empire, the Victorian Age, and the era of Winston Churchill.

HH336 Philosophy of Religion (3-0-3). A philosophical analysis of the central concepts and problems of the Judeo-Christian tradition. The nature of religion, faith, God, evil, and immortality examined from Plato through the death-of-God theologians. Prereq: 1/C or 2/C only, or permission of instructor.

HH340 Philosophy of Science (3-0-3). An examination of the impact of science on 20th century society, the values assumed by science, and the nature of scientific discovery and experimentation. Prereq: 1/C or 2/C only, or permission of instructor.

HH345 History of Colonial America (3-0-3). The origins of American civilization from the Age of Discovery to 1776. Emphasis is placed upon the founding of the colonies and their institutional development.

HH346 Revolutionary and Early National History (3-0-3). Traces the revolutionary movement and the subsequent development of the new nation, emphasizing the coming of the revolution, the institutionalization of the revolutionary ideal, and the dual development of nationalism and sectionalism.

HH347 Civil War and the Emergence of Modern America (3-0-3). An examination of the political, economic, and social developments from the beginning of the Civil War to World War I, including the wounding of the nation in a civil war and the reunification that made the United States a great power.

HH348 History of Recent America (3-0-3). An examination of the political, social, and economic developments from the Progressive era to the Cold War, including World War I, the Era of Normalcy, the New Deal, and World War II and its aftermath.

HH353 American Social History (3-0-3). An examination of American life and culture and the forces that have shaped them, emphasizing mass media, popular entertainment, religious movements and technological advances.

HH354 American Diplomatic History (3-0-3). An examination of American foreign relations from the War for Independence through the Cold War. Particular attention is paid to the policies of presidents and secretaries of state, and to the combination of forces that affected the conduct of the nation’s foreign relations.

HH357 History of American Minorities (3-0-3). Surveys the experiences and accomplishments of disadvantaged groups in American society from colonial times to the present. While black history and culture will be emphasized, the experiences of other racial minorities, ethnic and religious groups, and women will be covered.

HH358 American Constitutional and Legal History (3-0-3). An examination of the American constitutional and legal systems from their pre-colonial background to the present. The course emphasizes the legal system as a product of American society during the particular era under consideration.

HH361 History of China and Japan (3-0-3). An analysis of contemporary Asian problems which considers their cultural and institutional origins, their 19th century development under the impact of Western influence, and their culmination in contemporary Asian nationalism.

"Imagination is more important than knowledge."

ALBERT EINSTEIN
"I have learned to seek my happiness by limiting my desires, rather than in attempting to satisfy them."

JOHN STUART MILL

HH362 History of the Middle East (3–0–3). A long range historical approach to the Middle East's role in world affairs and the development of its cultural, political, and military institutions. Emphasis is placed on strategic and diplomatic considerations.

HH363 History of Latin America (3–0–3). The impact of Europe in the colonial period, the independence struggle, the rise of national states, and the interplay of world forces upon the shaping of 20th century Latin American life.

HH366 History of Imperialism and Decolonization (3–0–3). A survey of the growth and dissolution of European and American overseas empires in the 19th and 20th centuries. Topics covered will include the "scramble for Africa," free trade and spheres of influence, strategic and economic imperialism, the process of decolonization, and the problems of emerging nations.

HH373 Western Martial Heritage (3–0–3). Surveys the evolution of the military art from the ancients through Napoleon, and relates the political and social effects of warfare and military systems on the development of Western civilization.

HH374 War in the Western World: The Age of Total War (3–0–3). Examines the dimensions of warfare since the French Revolution and civil-military relations in a broad social context.

HH375 Western Economic History (3–0–3). A study of the rise of industrialization, the evolution of financial institutions, the expansion of international trade, and changes in labor, agriculture, and transportation in the development of national economic policy, with special emphasis on Europe and the United States from the rise of capitalism to the present day.

HH377 Western Cultural History (3–0–3). An introduction to the major epochs of Western development in the fine arts, this survey examines the evolution of contemporary painting, sculpture, architecture, and music as well as the individuals and societies that produced them.

HH380 History of Science and Technology (3–0–3). A cross-cultural survey of the history of scientific discoveries and their practical applications, from the early natural philosophers to the present, with emphasis on the scientific revolution of the 17th century, the Industrial Revolution, and the information explosion of the 20th century.

HH470 History of Military Thought (3–0–3). A study of warfare and military institutions through the views of the military leaders most influential in formulating and changing them, from ancient times to the present. Prereq: HH373 and HH374 or permission of instructor.
The Department offers courses at all levels in Chinese, French, German, Russian, and Spanish. Midshipmen majoring in Economics, English, History or Political Science take or validate four semesters of a given language and have the option of continuing with one or two advanced language courses. In other majors, midshipmen eligible for advanced language courses (300-400) may take them as humanities-social science electives. Any midshipman may take language courses at the 100-200 level as free electives.

French Courses

**FF101 & FF102** Basic French I & II (3–0–3, 3–0–3).
Emphasizes the spoken language.

**FF201 & FF202** Intermediate French I & II (3–0–3, 3–0–3).
Continues development of oral, reading, and writing skills. Includes area and cultural topics. Prereq: FF102.

**FF301 & FF302** Advanced French with Civilization Readings I & II (3–0–3, 3–0–3).
Continues development of oral, reading, and writing skills. Includes area and cultural topics. Prereq: FF202.

**FF411 Development of French Civilization (3–0–3).**
From the origins to World War II. Prereq: FF302 or approval of department chairman.

**FF412 Modern France (3–0–3).**
Contemporary French society, institutions, and national policies. Prereq: FF302 or approval of department chairman.

**FF421 & FF422** Representative Readings in French Literature I & II (3–0–3, 3–0–3).
Analysis and discussion of works of leading writers of various periods. Prereq: FF302 or approval of department chairman.

German Courses

**FG101 & FG102** Basic German I & II (3–0–3, 3–0–3).
Emphasizes the spoken language.

**FG201 & FG202** Intermediate German I & II (3–0–3, 3–0–3).
Continues development of oral, reading, and writing skills. Includes area and cultural topics. Prereq: FG102.

**FG310 Introduction to Contemporary West Germany (3–0–3).**

**FG320 Introduction to German Literature (3–0–3).**
In German. Stresses development of advanced German language skills. Prereq: FG202.

**FG311 Development of German Civilization (3–0–3).**
From the medieval period to World War II. Prereq: FG310 or approval of department chairman.

**FG412 Modern Germany (3–0–3).**
Contemporary German society, institutions, and national policies. Prereq: FG310 or approval of department chairman.

**FG421 & FG422** Representative Readings in German Literature I & II (3–0–3, 3–0–3).
Analysis and discussion of works of leading writers of various periods. Prereq: FG320 or approval of department chairman.

Chinese Courses

**FC101 & FC102** Basic Chinese I & II (3–0–3, 3–0–3).
Emphasizes the spoken language. Provides introduction to writing system.

**FC201 & FC202** Intermediate Chinese I & II (3–0–3, 3–0–3).
Continues development of oral skills. Includes exercises in character recognition, and reading of graded cultural texts. Prereq: FC102.

“A professional is someone who does the things he doesn't like as well or better than the things he likes to do.”

REAR ADMIRAL KINNAIRD R. MCKEESuperintendent,U.S. Naval Academy, 1975–78
“Curiosity is one of the permanent and certain characteristics of a vigorous intellect.”

SAMUEL JOHNSON

Department of Economics

Economics Major

The major in Economics is designed to acquaint prospective naval officers with both macro- and micro-economic theory, with quantitative methods in economics, with economic problem-solving in an institutional context, and with international economic relations of the United States. An undesignated Bachelor of Science degree is awarded.

Curriculum Requirements (In addition to the requirements of plebe year)

Professional: NN203, NL200, EN200, NS252, NS300, NL303, NN302, EN300, EE311-312, ES400, NL400;
Mathematics: SM211, SM212;
Science: SP201, SP202;
Humanities/Social Science: HE300* and one elective course;

ish-American Literature I & II (3-0-3, 3-0-3). Novels, stories, essays, and plays reflecting the characteristics and civilizations of major South American countries. Prereq: FS304 or approval of department chairman.

Russian Courses

FR101 & FR102 Basic Russian I & II (3-0-3, 3-0-3). Emphasizes the spoken language.

FR201 & FR202 Intermediate Russian I & II (3-0-3, 3-0-3). Continues development of oral, reading, and writing skills. Includes area and cultural topics. Prereq: FR102.


FR340 Writings from Post-Stalin Russia (3-0-3). Continues emphasis on spoken Russian. Discussions of Soviet civilization and culture, including naval and military topics. Prereq: FR202.

FR411 Development of Russian Civilization (3-0-3). From the 10th century to World War II. Prereq: FR340 or approval of department chairman.

FR412 Modern Russia (3-0-3). The Soviet Union since World War II: social, cultural, economic patterns; technology, armed forces, national policies. Prereq: FR340 or approval of department chairman.

English Course

FX101 & FX102 English for Non-Native Speakers I & II (3-0-3, 3-0-3). Alternative to common plebe year courses HE111 & HE112. Prereq: approval of department chairman.
Language: Four semesters of a modern language; Special: none; Major: FE210, FP210 or FP230 or FP438, FE312, FE331, FE341, FE486 and five elective courses in economics with at least two at the 400-level; Restricted elective: one.

* Taken during second class summer

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**Economics Courses**

**FE210 Basic Economics** (3–0–3). An introductory course in elementary economic theory and its application to contemporary problems. Topics include income determination, monetary policy and institutions, public finance, price theory, and international trade.

**FE245 Environmental Economics** (3–0–3). Economic evaluation of policies involving conflicting public and private uses of natural resources. Topics include environmental benefit and cost measurement, causes and consequences of pollution, management of depletable and renewable resources, and the economics of energy. Not offered every year. Prereq: FE210.

**FE310 Economic Geography** (3–0–3). Provides a systematic understanding of economic growth and the issue of finite limits to improved living standards around the world. Studies population growth, the resources of the principal nations of the world, industry location, international trade, commodity cartels, and the requirements for continued technological advance.

**FE311 History of Economic Thought** (3–0–3). Traces the evolution of economic doctrine from the ancients to modern day with emphasis on the period since the 18th century. Reviews the contributions to economic knowledge by Smith, Malthus, Ricardo, Marx, Mill, Marshall, Keynes, and others. Various schools of thought such as mercantilism, classical, neo-classical, historical, institutionalism, and Keynesianism are examined. Prereq: FE210.

**FE312 Macroeconomics** (3–0–3). The significance and determinants of the aggregate levels of income and employment, the price level, consumption, interest rates, investment, alternative monetary and fiscal policies. Prereq: FE210.

**FE321 Comparative Economic Systems** (3–0–3). An introduction to the study of alternate forms of economic organization, with emphasis on comparing the ideological basis, structure, and performance of capitalist, socialist, and mixed economic systems.

**FE331 Descriptive Economic Statistics** (2–2–3). Survey of descriptive and analytic techniques involving one, two, and three or more variables or attributes. Introduction to probability and statistical inference. Prereq: FE210 and Calculus I.

**FE341 Microeconomics** (3–0–3). Theories of the economic behavior of consumers and producers, the determination of final good and factor prices, market structures and general economic equilibrium. The application of price theory to business problems and public-policy issues. Prereq: FE210.

**FE351 The Economics of Government-Business Relations** (3–0–3). A study of the economic interaction of government with the business community. Emphasis is on policies to maintain competition through antitrust enforcement and regulatory controls. Consideration is given to the effect on industrial organization, market structure, resource allocation, and income distribution of these and other government policies relating to safety, equal employment, energy, housing, agriculture, etc. Prereq: FE210.


**FE362 The Economics of Technology** (3–0–3). An analysis of productivity growth, characteristics of invention and innovation, determinants of research and development activities of government and business; the economic impact of automation, and reindustrialization. Prereq: FE210.

**FE411 Economics of Developing Nations** (3–0–3). Study of the economic characteristics, problems, and policies of developing nations, covering economic growth patterns in Third World nations, their changing role in the international economic order, and the different economic routes being employed toward economic progress. Prereq: FE210.

**FE412 International Trade and Finance** (3–0–3). Study of international economic relations, especially trade and protectionism, multinational enterprise, the world monetary system, and regional integration. Primary emphasis on relations between the developed nations of North America, Europe, and the Pacific Basin. Case studies of current issues cover OPEC, commodity cartels, and relations with socialist nations. Prereq: FE210.


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"I thought about (college) ROTC, but it seemed like it was half in the military, half out."
“Under all circumstances, a decisive naval superiority is to be considered a fundamental principle, and the basis upon which all hope of success must ultimately depend.”

GEORGE WASHINGTON

FE422 Economics of Labor Relations (3–0–3). A study of the distribution of income with emphasis on the demand for and supply of labor services; the choice-theoretic behavior of firms and individuals in the determination of wages and the employment level. Topics analyzed include human capital theory, the wage effects of discrimination and unions, occupational choice, and the unemployment-inflation relationship. Labor laws, union history and institutions are discussed. Prereq: FE210.

FE431 Public Finance (3–0–3). The use, in a market economy, of government expenditures and taxation to change the allocation of resources and to modify the distribution of income. Examination of the economic effect of government budgetary policy. Microeconomic theory. Federal tax and budgetary institutions are emphasized. Prereq: FE210.

FE434 Money and Banking (3–0–3). A consideration of central and commercial banking institutions; an investigation of the demand for money and its role as a focal point for monetary policies designed to obtain full employment, price stability and international monetary equilibrium. Prereq: FE210.

FE445 Econometrics (3–0–3). Quantification of basic economic theory: multiple regression, correlation, and identification techniques for the construction and testing of economic models, and a study of selected alternative models of particular economic interest. Not offered every year. Prereq: FE210 and Calculus I & II.

Department of Political Science

Political Science Major

The major in Political Science is designed to acquaint prospective naval officers with the elements of political analysis. It provides an understanding of the structure and functions of international politics and of various political systems and analyzes related problems and issues. The wide range of courses allows midshipmen to select an area of concentration within the discipline, such as American or international politics, comparative and international politics of regions, and political theory. The program includes a requirement for four semesters of a modern language, with an opportunity to take additional language, economics, and history courses. An undesignated Bachelor of Science degree is awarded.

Curriculum Requirements (In addition to the requirements of plebe year)

Professional: NN203, NL200, EN200, NS252, NS300,* NL303, NN302, EN300, ES300, EE311–312, ES400, NL400;
Mathematics: SM211, SM212;
Science: SP201, SP202;
Humanities/Social Science: HE300* and three elective courses;
Language: Four semesters of a modern language;
Major: FP210, FP220, FP230, FE210 and six approved political science courses plus one approved history or economics course;
Restricted elective: one.

* Taken during second class summer

Political Science Courses

FP210 Introduction to International Relations (3–0–3). Introduction to the various approaches to international relations; the nature of the international political system; foreign policy analysis; the principles, theories, machineries and major problems of international relations.

FP220 Political Science Methods (3–0–3). A discussion of the philosophy of science for the political scientist and instruction in research methods with emphasis on quantitative techniques. Prereq: Political Science major or permission of department chairman.
FP230 United States Government and Constitutional Development (3-0-3). Areas of study include the basic concepts of American democracy, the Constitution and its development, the political process, and the structure and functions of the national government and the factors which influence its operation.

FP241 Introduction to Political Behavior (3-0-3). An analytical treatment of political behavior from psychological, sociological and cultural perspectives. Focuses on the formation of attitudes through socialization and personality development.

FP311 Administration in Government (3-0-3). A critical analysis of management in the public service with emphasis, through the use of the case method, on actual instances of public administration in the area of national defense. Not offered every year. Prereq: FP230 or consent of instructor.

FP312 Communism: Theory and Practice (3-0-3). The philosophy of Communism, the Comintern, relations of the Soviet Union with radical parties outside Russia and with European Social Democratic Parties.

FP313 Science, Technology and International Relations (3-0-3). The effect of science and technology on both the national and international political systems. The role of the scientist, development, and research in national and world decision-making. Special emphasis is given to nuclear non-proliferation, space cooperation, and environmental control.

FP314 Formulation of U.S. Foreign Policy (3-0-3). The formulation and execution of the various American foreign policies to include: constitutional roles, the decision-making structure, military input to policy-making, the administration of foreign policy, agencies, procedures and practices. Substantive policy is analyzed in light of decision-theory, ends-means and capability analysis. Prereq: upper class.

FP322 Comparative European Politics (3-0-3). Using a contemporary and comparative approach, this course focuses on the structures and functions of the political systems of some of the principal European nations.

FP323 Comparative Latin American Politics (3-0-3). An analytical treatment of the structure and dynamics of independent Latin American political systems, individually and in comparison; parties, interest groups, the military, the church, revolution, foreign policy, and political thought.

FP324 Latin American International Politics (3-0-3). The Inter-American System; patterns of Inter-Latin American and extrahemispheric relations; the Latin American policy of the United States.

FP325 American Political Theory (3-0-3). A detailed analysis of the currents of American political theory from the 18th century to the present. Trenchant concepts are critically analyzed in world perspective.

FP326 The American Presidency (3-0-3). The growth and evolution of the Office of the President, executive agencies; their function, control and problems. Special attention is given to the President's role as Commander-in-Chief, and his relations with the legislative and judicial branches. Prereq: FP230 or consent of instructor.

FP328 The Legislative Process (3-0-3). A comparative examination of the legislative process at all levels of American government with special emphasis on congressional-military relations. Prereq: FP230 or consent of instructor.

FP335 Civil-Military Relations (3-0-3). An interdisciplinary approach to the complex nature of civil-military affairs. Prereq: FP230 or consent of instructor.

FP337 Chinese Political and Military Systems (3-0-3). An examination of Chinese political and military systems from 1927 to the present. Emphasis is placed on economic, political, and foreign policies of the Chinese Communist regime. Not offered every year.

FP338 African Politics (3-0-3). An introduction to the political trends and constitutional developments of present day African governments; their relations with one another and the rest of the world. Attention is directed to the U.S. security aspects of African national growth.


FP365 Comparative Asian Politics (3-0-3). A systematic comparative approach to the study of Asian governments, their political, economic and military development, regional relationships and problems. Not offered every year.

FP369 Middle Eastern Politics (3-0-3). A comparative analysis of politics and institutions including foreign policy of Middle Eastern nations. The conflict of nations within this system and the worldwide effects are emphasized. Not offered every year.

FP370 Soviet Foreign Policy (3-0-3). Analysis of the geopolitical, ideological, institutional, cultural, and economic factors affecting the formulation and conduct of Soviet foreign policy in relation to the United States, Europe, China, and the Third World.

FP371 Asian International Politics (3-0-3). An examination of the Asian nations' political relationships with each other and the rest of the world with special emphasis on U.S.-Asian relations. Not offered every year.

"You won't last long in the fleet if turning up the volume is the only tool you have."

REAR ADMIRAL
J. A. WINNEFIELD
Commandant of Midshipmen, 1976-77
"I personally feel that anybody who is picked to be a midshipman can make it through here if he wants to."

PP372 Political Parties and Pressure Groups (3-0-3). A study of the dynamics of group politics in the American system of government. Emphasizes the roles played by parties, interest groups, public opinion, and elections in the American political process. Prereq: FP230 or consent of instructor.

PP394 Political Theory (3-0-3). A study of political philosophy, with emphasis on the roots of democracy: the writings of the major writers from Plato to the present.

PP397 American Judicial Process (3-0-3). An examination of the judicial process at the federal and state levels including the nature and limits of the law and the key actors: defendant, prosecution, defense, judge, jury, and corrections personnel. Prereq: FP230 or consent or instructor.

PP400 International Law (3-0-3). A survey of the public law of nations including the law of peace, the law of war, and law of the sea. Problems and case studies are used extensively.

PP411 Constitutional Law (3-0-3). A survey of the basic principles of the Constitution, particularly the civil and political rights of the individual, as determined by the Supreme Court. Prereq: FP230 or consent of instructor.

PP412 Perspectives of American Law (3-0-3). A study of the American system of law, including its role in the political process, the basics of court structure and procedure, torts, crimes, contracts, negotiable instruments, real property, business associations, transfer of property at death, insurance, and agency.

PP421 National Security Policy (3-0-3). Stresses the interaction of domestic, foreign and military considerations in the making and execution of national security policy. Case studies and national strategic estimates highlight the course. Prereq: FP230 or FP210 or consent of instructor.

PP437 International Organizations (3-0-3). A study of the expanding role of international organizations, particularly in the security field, since the end of World War II. Special attention is given to the U.S., to major regional systems, and the U.S. role in multilateral diplomacy. Prereq: FP210 or consent of instructor.

PP438 Comparative Government and Politics of Developing Areas (3-0-3). Governmental and political problems, institutions and behavior in developing areas. Political thought, impact of change, leadership and organization in Africa, Asia, and Latin America. Not offered every year.
Division of Professional Development

Department of Leadership and Law
Department of Seamanship and Navigation

Department of Leadership and Law

Leadership and Law Courses
All midshipmen regardless of major must complete the following courses:

**NL102 Leadership I: Fundamentals of Naval Leadership** (1-2-2). An introductory course to instill in midshipmen a professional sense of purpose and personal honor, as well as those significant military leadership traits and techniques which will ensure credibility in the communication of their ideas and commands, and give them an appreciation of individual and organization factors which influence their performance as leaders.

**NL200 Leadership II: Human Behavior** (3-0-3). A study of theory and principles of individual and group behavior and their relationships to effective leadership in the naval service. **Prereq:** NL102.

**NL303 Leadership III: Application** (3-0-3). A culminating course to reinforce the practical aspects of leadership in the naval service, utilizing the case study process to aid midshipmen in formulating their own style of leadership. **Prereq:** NL200.

**NL400 Law for the Junior Officer** (2-0-2). A survey of the major aspects of military justice and the law of war relevant to the junior naval officer. **Prereq:** NL303.

Department of Seamanship and Navigation

Seamanship and Navigation Courses
All midshipmen, regardless of major, must complete the following courses:

**NS101 Fundamentals of Naval Science** (2-2-3). Introduction to the basic concepts of seamanship and shiphandling including laboratories on YTs, MSLs, an outdoor damage control trainer, and an indoor seamanship trainer. Instruction includes operational and administrative organization, communications, damage control, and basic weapons systems.

**NN203 Navigation I** (2-2-3). Terrestrial navigation including piloting and navigation systems for surface navigation, basic meteorology and Inland Rules of the Nautical Road. Labs include practical exercises and YP drills afloat. **Prereq:** NS101.

**NS252 Shiphandling and Tactics** (1-2-2). A course of professional instruction covering the art and science of shiphandling, ship control, radar piloting, tactics, special seamanship and operational evolutions with emphasis on the development of midshipmen as capable mariners. **Prereq:** NS101, 3/C cruise.

**NS300 Operations and Tactics** (2-2-3). Develops the midshipman's proficiency in advanced shiphandling, tactics, and piloting during extended underway periods. Midshipmen form the nucleus of a ship's organization aboard a YP and function

"No sane man is unafraid in battle, but discipline produces in him a form of vicarious courage."

GENERAL GEORGE S. PATTON, JR.
in leadership and administrative roles similar to those aboard fleet units. *Prereq: NS101, NN203, and NS252.*

**NN302 Navigation II (2-2-3).** Celestial navigation and electronic navigation with instruction in International Rules of the Road; practical exercises and YP drills afloat. *Prereq: NN203.*

The following course is offered as an elective:

**NN412 Air Navigation Systems and Air Traffic Control (3-0-3).** An advanced study and application of air navigation, including electronic, celestial and airways navigation methods and procedures. *Prereq: NN302.*
Academy-Wide Seminars and Research Projects

Academic departments may offer seminars and individual research projects to upper classmen on the following basis:

Seminars:

XX 481 and XX 482  1-0-1
XX 485 and XX 486  3-0-3 Advanced topics

Research Projects:

A creative project in the student's field of interest. A faculty advisor must approve and monitor each project.

Prerequisite: approval of department chairman.
XX 491 and XX 492  0-2-1
XX 493 and XX 494  0-4-2
XX 495 and XX 496  0-6-3

Note: XX represents the departmental designator.

"The only problem here is that you don't have the freedom to get up and go when you want to. But freedom is in the mind, anyway. I love it here."
The overall program at the Naval Academy is designed to provide midshipmen with a broad academic and professional foundation upon which they will be able to build competence in any of the warfare specialities they may elect to follow at graduation: surface warfare, aviation, the submarine service, or the Marine Corps. The development of a strong sense of commitment to the naval service and the fostering of high personal standards are major aims of our program.

Professional development of midshipmen is the overall responsibility of the Commandant of Midshipmen. This development starts on the very first day of plebe summer and continues through graduation four years later. It consists of professionally oriented classroom studies (in all, 15 courses during the four years) and of drills and practical training conducted at the Academy during the academic year, as well as of professional training conducted during the summer at shore bases and at sea with units of the Fleet. Included are instruction and training in navigation, seamanship and tactics, naval engineering, naval weapons, leadership, and military law.

Each midshipman’s professional development is monitored and graded throughout the years at Annapolis. These grades are considered along with grades achieved for academic studies in other (non-professional) areas of the curriculum in determining a midshipman’s class standing at graduation.

A summary of the Naval Academy’s program for the professional development of midshipmen follows:

**Fourth Class Summer**

*Introduction to Seamanship.* Practical instruction in elementary seamanship, sailing sloops and yachts, powerboat handling, rules of the nautical road, visual signalling, and basic damage control.

*Physical Education Orientation and Indoctrination.* Preliminary examinations in swimming, posture, and athletic ability. Drills in fundamentals of swimming, boxing, wrestling, hand-to-hand skills, posture, and personal conditioning. Indoctrination drills in lacrosse, fencing, soccer, rugby, gymnastics, crew, golf, tennis, squash racquets, and track.

“Of all careers, the Navy is the one which offers the most frequent opportunities to junior officers to act on their own.”

NAPOLEON
Without a decisive Naval force we can do nothing definitive. And with it, everything honorable and glorious.

GEORGE WASHINGTON

Small Arms. Practical instruction in nomenclature, field stripping, and assembly of small arms. Firing of service pistol. Midshipmen who qualify are awarded the Navy Expert Pistol Medal.

Indoctrination. The plebe summer indoctrination program is designed to provide a fundamental knowledge of the Naval Academy and the Navy and a thorough indoctrination into plebe responsibilities. The program is fundamental to the smooth transition of each midshipman from civilian life to life as a member of the Brigade of Midshipmen. The strenuous and demanding regimen prepare the plebe for rigors of the four-year program and provides the basis for future development of professional competence, integrity, and physical and mental stamina.

Fundamentals of Naval Hygiene. The fundamentals of personal hygiene, including mental and physical hygiene and first aid.

Fourth Class Year

PE101 & 102 Physical Education. Instruction in the fundamentals of swimming, boxing, wrestling, gymnastics, hand-to-hand skills, soccer, golf, tennis, volleyball, basketball, handball, squash racquets, and personal conditioning. Tests in applied strength, mile run, swimming, boxing, wrestling, gymnastics, and on the obstacle course. (Women midshipmen participate in hand-to-hand skills in place of boxing and wrestling.)

Infantry Drill. Approximately 13 hours of infantry drill during both the fall and spring, four hours of which are devoted to Brigade dress parades.

Professional Courses. Three introductory professional academic courses in the fields of naval engineering, leadership, and naval science are taken during plebe year. These courses lay the groundwork for more advanced professional studies at the Academy. Engineering topics include the basic operation, function, and components of propulsion systems and auxiliary engineering equipment. Basic shiphandling, watch and battle organization, communications, and command and control centers are topics presented in the first of three naval science courses. The initial leadership course is designed to strengthen each midshipman's sense of responsibility, accountability, and personal integrity.
Third Class Summer

At-Sea Training. Midshipmen are sent to units of the Fleet on both coasts of the United States as well as to the Sixth Fleet in the Mediterranean and the Seventh Fleet in the Pacific for summer-at-sea training. Some midshipmen cruise on the Naval Academy’s yard patrol craft (YP’s) to various ports and training facilities along the Atlantic seaboard. Third classmen are introduced to Navy life at sea, to shipboard organization and relationships, and to the leadership opportunities and challenges of a junior officer. Midshipmen actively participate in a wide range of shipboard tasks and evolutions under normal and simulated emergency conditions, both at sea and in port. They stand deck and engineering watches, participate in gun and missile evolutions, and become familiar with shipboard equipment. Each midshipman is required to complete a cruise training journal.

Third Class Year

PE201 & 202 Physical Education. Continuation of instruction in tennis, swimming, boxing, and wrestling. Instruction in the basics of judo. Tests in applied strength, mile run, swimming, boxing, and on the obstacle course. (Women midshipmen participate in judo and fencing in place of boxing.)

Infantry Drill. Approximately 13 hours of infantry drill during both the fall and spring, four hours of which are devoted to Brigade dress parades.

Professional Courses. Four professional academic courses are taken during “youngster year.” The first of two navigation courses, Navigation I, presents an introduction to the art and science of terrestrial navigation. Topics include chart reading, piloting (position plotting), and principles of basic weather phenomena. A naval engineering course offers studies in ship construction and system acquisition, material strength, and ship stability. The second of three leadership courses emphasizes psychology and considers the application of human behavior theory to effective leadership. The second naval science course provides instruction in the art and science of shiphandling, radar piloting, and tactics.

Second Class Summer

Aviation, Submarine, Surface Line, and Marine Corps Orientation. Broad professional training in aviation, submarines, surface line, and the Marine Corps is conducted at bases away from the Naval Academy. In addition, during second class summer, each midshipman completes four weeks of professional and academic training at the Naval Academy which includes afloat operations and tactics on yard patrol craft (YP’s); an introduction to Naval tactical warfare, which employs computer war games to evaluate the Soviet naval threat and U.S. counter tactics; and public speaking.

Second Class Year

PE301 & 302 Physical Education. Advanced instruction in tennis, swimming, the principles of personal conditioning, officiating, and the principles of hand-to-hand combat. Electives in handball, squash, and volleyball. Tests in applied strength, swimming, mile run, and the obstacle course.

Infantry Drill. Approximately 13 hours of infantry drill during both the fall and spring, four hours of which are devoted to Brigade dress parades.

"No matter how important a man at sea may consider himself, unless he is fundamentally worthy, the sea will find him out.”

CAPTAIN F. RIESENBERG
**Professional Courses.** The majority of a midshipman’s professional academic courses, six courses in all, are taken during second class year. Navigation II is a continuation of the first navigation course with emphasis on celestial plotting, including celestial motion, development of various coordinate systems, solution of the navigation triangle, rules of the nautical road, and electronic navigation. Naval Weapons Systems includes sensor, tracking, computational, fire control, and delivery systems. Naval Engineering II concentrates on the principles of operation of fossil-fueled steam propulsion and gas turbine plants as well as the basic elements of thermodynamics. Courses in naval electricity and in electronics are also taken. The last of three leadership courses taken at the Academy is designed to enhance each midshipman’s knowledge and understanding of responsibility, accountability, and authority; management techniques; problem solving applications for organizations; and the processes of decision-making.

**First Class Summer**

**At-Sea Training.** During their last summer of at-sea training with the Fleet, first class midshipmen undertake the administrative responsibilities and stand the watches of junior officers. They complete extensive practical work in navigation, taking celestial sightings and determining the ship’s position. They are required to complete a cruise training journal, summarizing watches and work in engineering, seamanship, navigation, weapons, operations, and in basic fleet tactics. Selected first class midshipmen may participate in a Marine Corps cruise with the First Marine Brigade in Hawaii. Here midshipmen learn first-hand what it is like to be an officer of Marines, working with Marines of all ranks in Marine ground units and aviation squadrons.

**First Class Year**

**PE401 & 402 Physical Education.** Instruction in advanced swimming, personal conditioning, and athletic administration. Tests in applied strength, running (mile run), swimming, and on the obstacle course. Electives in squash racquets, tennis, golf, handball, and volleyball.

**Infantry Drill.** Approximately 13 hours of infantry drill during both the fall and spring, four hours of which are devoted to Brigade dress parades.

**Professional Courses.** The final two of the 15 professional academic courses are taken during first class year. The second weapons course provides midshipmen with the principles employed in weapons systems design, and exposes them to the complexities of modern-day weapons system integration. A law course, designed for junior officers, addresses procedural and substantive military law as well as international law and personal responsibilities.

**Professional Competency Review (PCR)**

The PCR consists of a series of comprehensive examinations administered to midshipmen of each class during the spring semester. The PCR measures whether or not each midshipman is making satisfactory progress toward achieving the level of professional competence required for graduation and commissioning. It provides an opportunity for midshipmen to annually evaluate their own professional strengths and weaknesses. The PCR also provides meaningful feedback on the effectiveness of the professional curriculum (seamanship, navigation, engineering, leadership, weapons, and summer programs) and thus with a measure of how well the Naval Academy is achieving its goals.

"Keep your sense of humor, a low profile, and remember—you’re midshipmen, not women midshipmen. That doesn’t mean you can’t be feminine. Just be prepared to learn how to do both and when.”