academics

Graduates of the Air Force Academy must be intellectually prepared to assume professional and leadership roles. The academic curriculum offers a balanced sequence of required courses that develops future Air Force officers with innovative, analytical and resourceful minds. You'll receive a broad education in the basic sciences, engineering, humanities and social sciences. The Air Force Academy offers 31 majors and two minors. You'll take elective courses and perform challenging independent research projects that prepare you for an uncertain global environment.

brigadier general dana h. born

Dean of the Faculty

Brigadier Gen. Born is the dean of the faculty. A graduate of the Air Force Academy, Class of 1983, the general has served in various support and command positions–including speech writer for the secretary of the Air Force in Washington, D.C.; executive officer, Exchange Office with the Royal Australian Air Force in Australia; and most recently as Professor and Department Head of the Behavioral Sciences and Leadership Department at the United States Air Force Academy. Gen. Born earned a Bachelor of Science (graduating with distinction) from the Air Force Academy, a master's in experimental psychology from Trinity University in Texas, a master's in research psychology from the University of Melbourne in Australia, and a doctoral degree in industrial and organizational psychology from Pennsylvania State University. She attended Squadron Officer School, Air Command and Staff College and the Air War College at Maxwell Air Force Base, Ala. General Born's decorations include the Defense Meritorious Service Medal, the Meritorious Service Medal with three oak-leaf clusters, and the Air Force Commendation Medal with one oak-leaf cluster. She assumed duties as the dean of the faculty in October 2004.

"The education of America's future leaders is paramount to our mission. Our primary role as faculty is to provide instruction and experience to all cadets so they graduate with the knowledge, character and motivation essential to leadership as career officers. Through challenging academic programs, the Academy provides the tools and opportunities to develop the reasoning, communication and problem-solving skills necessary for our future officers. Equally important is the faculty's responsibility to help cadets develop integrity and character as we motivate them toward military service. Serving as professional role models, Academy instructors—the majority of whom are Air Force officers—combine the finest academic preparation with a wide variety of Air Force skills and specialties to enrich classroom instruction. Through highly personalized academic counseling and student assistance, our faculty and staff are dedicated to providing each cadet with the greatest opportunity for success. For those cadets who excel academically, the Academy offers many postgraduate scholarships to further enhance the young officer's professional development. The faculty is governed by three guiding principles: provide a quality education, promote trust and responsibility, and be a community of airman-scholar-citizens. With this focus, we are able to graduate knowledgeable and motivated cadets committed to integrity, excellence and selflessness."

semester schedule

The fall and spring semesters contain approximately 17 weeks of instruction (40 lessons), and they extend from early August to the week before Christmas and the first week in January through mid May. Each semester includes five days for final examinations. A limited number of three-week academic courses are offered for the third-, second- and first-class cadets during the Academy's 10-week summer term. Early in BCT, you'll take placement examinations offered by the academic departments. Your individual ability, preparation and achievement determine what classes you'll take during your first semester.

grading

Most courses at the Academy are graded on a grade point scale, with an "A" worth four quality points per semester hour and an "F" worth zero. Performance on quizzes, examinations and class recitations determine your grades. You'll receive a pass/fail grade in most non-academic courses, particularly military training and airmanship. You should normally spend two hours in outside preparation for each hour spent in class. You receive a progress report at mid-semester and a final report at the end of the semester.

cadet achievement

A semester 3.0 or greater grade point average (GPA) earns you a place on the Dean's List, and you may wear a silver star on your uniform. A silver wreath shows you're on the Commandant's List and have earned a military performance average (MPA) of 3.0 or greater. Cadets who earn a 3.0 or greater physical education average (PEA) are awarded a silver lightning bolt by the director of athletics. You may be entitled to wear any two of these awards in combination. If you earn all three, you'll wear a silver star within the wreath surrounded by two lightning bolts to show you're on the Superintendent's List. If you're on any of these lists, you may be awarded additional privileges on weekends.

undergraduate research and enrichment opportunities

The USAF Academy runs the largest undergraduate research program in the United States, with a cutting-edge program spanning 14 research centers and two research institutes, ranging from aeronautics and astrophysics to behavioral sciences, and from small satellite design to national security studies and English literature, to name but a few. In addition to working in our world-class laboratories, approximately 180 rising seniors are chosen for a summer research internship with one of dozens of outside partners including Boeing, Lockheed Martin, the National Security Agency and the Air Force Research Laboratory. You may engage in independent study and enjoy the challenge of mentored one-on-one research with a faculty member in your chosen major. Most projects have Air Force or Department of Defense financial support and relevance.

academy scholars program

The Academy Scholars Program helps competitively-selected cadets reach their full potential by offering a challenging path through the curriculum, thereby providing the Air Force and our nation with a pool of intellectually inspired and well-rounded leaders. The curriculum initially consists of special core course sections (core substitutes) that deepen the scholars' intellectual development, primarily in the liberal arts. The pedagogical principle of this enrichment program involves forming small learning communities (a cohort of cadets enrolled in the same sections) to provide close interaction among the same students over a four-year period, in courses pursuing a coherent theme – the development of the Western intellectual tradition.

post-graduate education opportunities

Graduating cadets can compete to receive scholarships to attend civilian graduate schools immediately after graduation. In addition, up to three percent of each graduating class may be sent directly to dental, medical or nursing school upon graduation. Many of our top graduates are offered future graduate education, provided they have performed well as officers and the Air Force has a need for the degree program they wish to pursue. These graduates will be eligible for attendance after three years on active duty. Normally during your career you'll attend one or more of the armed forces' schools for advanced professional studies. Although there is no provision for direct entry into law school immediately upon graduation, graduates may compete for law school once on active duty.

career opportunities

Many graduates choose the Air Force as a profession and remain in the service for at least 20 years. Professionals expect monetary reward and job security, so you can count on these benefits as an Air Force officer. Added to a competitive promotion system and accompanying base salary are allowances for food, quarters, and bonuses for flying or special skills, such as language fluency or doctor. Medical, commissary, base exchange, base housing and many other services are available to you and your dependents. Travel opportunities and a generous leave policy round out this benefits package. Retirement pay is based on at least 20 years of military service.

As the Air Force moves into the 21st century, it faces an increasingly complex global environment. To meet the challenges ahead, we will need a number of Air Force officers with specialized language skills to operate in a multinational environment. Officers with cultural and foreign language skills interact more effectively with allies and enhance teamwork. If you are already fluent in a language other than English and have experience in a multinational environment, you may be eligible for advanced training and assignments in the International Affairs Specialist or Regional Affairs Specialist programs during your career.

In support of changing technological needs, the Air Force recently created a new career path in Unmanned Aerial Systems and Remote Piloted Aircraft (UAS-RPA). The Academy's newest airmanship program, the UAS-RPA program, develops cadet understanding and practice of Air Force unmanned aviation as an application of airpower through such fundamentals as airmanship, situational awareness and weapon and sensor platform capabilities. The UAS-RPA program joins the soaring, parachuting and powered flight program as airmanship options cadets may take during their time at the Academy

A career in the Air Force involves obligations as well as benefits. You'll be expected to be a professional, use the leadership skills you developed as a cadet, and serve your country with dedication.

validation credit

Scores received on AP/IB exams are not used for admission consideration. However, if you score well on the AP/IB tests, you may validate some Academy courses. Some departments administer placement tests once you arrive; earning high marks on the test may enable you to be placed in an accelerated or advanced course or perhaps receive validation credit and substitute another course. Following is a listing of Academy departments accepting AP test scores.

Department	**Course**	**AP Test**	**IB Test**	**Comments**
Behavioral Science	Beh Sci 110	4/5 in psychology	6/7	
Biology	Bio 315	4/5	6/7	
Chemistry	Chem 100/200	3/4/5		
Computer Science	Comp Sci 110	4/5		Generally required to take course if student has taken only the AP Microeconomics exam
Economics	Econ 201	4/5		
English	English 111	5 in literature/ composition or language/composition	5/6/7	IB exam transcript must show English taken at the higher level (HL)
Foreign Language	For Lang 131/132	4/5		
History	History 101	5		World History
History	History 345	5		European History
History	History 352	5		American History
Mathematics	Math 141	4/5 AP Exam		Plus adequate score on AFA Placement Exam
Mathematics	Math 142	4/5 AP BC Exam		Plus adequate score on AFA Placement Exam
Mathematics	Math 300	4/5 AP Exam		
Physics	Physics 110/215	4/5 AP Physics C		

With a 3.25 GPA, you may overload courses, taking classes beyond the normal semester maximum for wider latitude in your course program planning. Upper-class cadets with a 2.60 GPA may audit a course beyond the normal semester maximum. Upper-class cadets with a 3.25 GPA may overload and audit a course. If a cadet audits a course, attendance is optional, no graded work is accomplished, and the audited course does not appear on the transcript.

Our academic core curriculum (32 three-semester-hour core courses) is designed to create an intentional, coherent whole organized developmentally to promote learning and growth in three main content areas:

- Culture and Global Awareness,
- Leadership and Human Behavior, and
- Science and Technology

The complete academic curriculum (core plus majors courses) for the Classes of 2011 and beyond consists of 47 three-semester-hour courses for disciplinary majors and 45 three-semester-hour courses for divisional majors. The curriculum breaks down as follows:

- 32 core courses
- 14 major's courses for disciplinary majors, 12 major's courses for divisional majors, and
- 9 elective courses for Bachelor of Science Program (BSP)
- 1 Academy Option course
- 1 First Year Experience (FYE, 1 sem hr)

= 48 courses, 142 sem hrs (disciplinary)/136 sem hrs (divisional)
+5 sem hrs (ten ½ sem hr Physical Education courses).
= 147 sem hrs total (disciplinary)/141 sem hrs total (divisional)/132 sem hrs total (BSP)

Generally, cadets complete the 47 course curriculum (plus FYE) by taking five courses during the fall semester of their fourth- class year and six courses during each of the subsequent seven semesters. The majors and course descriptions are listed later in this section.

exchange programs

Selected cadets experience the traditions and cultures of foreign countries during spring break exchange visits of seven to 10 days with the Air Force academies of Argentina, Bolivia, Brazil, Chile, Colombia, Egypt, England, Germany, Japan, Jordan, Korea, Malaysia, the Philippines, Peru, Spain, Turkey and Ukraine, among others. Each fall semester, 24 cadets participate in a semester exchange program with some of these countries' air force academies, where they experience in-depth the academic, military, athletic and social activities of the host academy. The Academy's semester exchanges are the following and were established in the years listed: France's Ecole de l'air in 1969,the German Offizierschule der Luftwaffe in 1996, the Chilean Escuela de Aviacion in 2000, the Spanish Academia del Aire in 2001, the Canadian Royal Military College in 2002 and the Japanese National Defense Academy in 2007. Additionally, we are currently exploring future exchanges with Arabic-, Chinese- and Russian-speaking academies. Also, during the fall and spring semesters, several second-class cadets trade places with their counterparts from West Point, Annapolis and the Coast Guard Academy. This interservice exchange provides a better understanding of the other services and enriches programs at the sister service academies.

study abroad

Selected cadets studying any of the eight languages currently offered at the Academy may experience a semester-long study abroad program at foreign civilian universities. Current programs exist with civilian universities in Austria, Brazil, China, Egypt, Japan, Mexico, Russia and Singapore. We continue to explore opportunities in other countries to grow this study abroad program.

degree paths

Several graduation paths are open to you, depending on your abilities and interests. The faculty has 20 departments offering 31 academic majors. There are 22 disciplinary, four divisional and five interdisciplinary majors.

graduation requirements

To graduate you must, a) demonstrate an aptitude for commissioned service and leadership, b) be satisfactory in conduct, c) be proficient in physical education and military training, d) complete the requirements for the core curriculum and for an academic major, and e) have a minimum cumulative and core GPA of 2.00.

accreditation

The Air Force Academy is a fully accredited institution of higher learning. The Higher Learning Commission of The North Central Association of Colleges and Schools, 30 N. LaSalle Street, Suite 2400, Chicago, Illinois 60602-2504, phone 312-263-0456, accredits the Bachelor of Science degree. The aeronautical engineering, astronautical engineering, civil engineering, computer engineering, computer engineering, electrical engineering, environmental engineering, mechanical engineering and systems engineering are accredited by the Engineering Accreditation Commission of ABET Inc., and the computer science program is accredited by the Computing Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, phone (410) 347-7700, composed of representatives of the major professional engineering and computing societies. The Committee on Professional Training of the American Chemical Society approves the chemistry, biochemistry and materials chemistry majors. The Association to Advance Collegiate Schools of Business (AACSB) accredits the management degree.

instructional methods

The Academy faculty uses lectures, discussions, demonstrations, tutorials and seminars in teaching. The small size of most classes, usually 15-20 cadets, makes the discussions practical and popular. The relaxed classroom atmosphere encourages free communication between the instructor and cadets. You may also receive extra instruction to develop your understanding of a subject and to improve your grades. Tests range from essay questions and themes to short-answer and multiple-choice items. Quizzes, graded reviews or final examinations determine your progress.

directorate of education

The Directorate of Education is a staff agency that includes; the Center for Educational Excellence, the Technical Assistance Center, the Air Force Institute for National Security Studies, and the Air Force Institute for Information Technology Applications. The purpose of the directorate is to enhance the quality of teaching and learning at the Academy. The Directorate of Education is the primary academic support agency for faculty development, academic assessment, institutional and programmatic accreditation, and educational technology integration.

office of the registrar

The office of the registrar staff administers the entire curriculum, from conducting registration to certifying you've met all degree and majors requirements, and coordinating the graduation ceremony.

student academic services

The Student Academic Services Center offers courses and individualized instruction designed to increase cadet academic performance. If you want to improve your time management, general study skills, reading rate and comprehension, writing skills, or need tutoring in a specific core course, the Student Academic Services Center staff can help. Services available to students include: the Writing Center, the Evening Tutoring Center (for extra help in chemistry, math, mechanical engineering and physics), the Reading Enhancement Program and the Study Skills Program. Information on graduate scholarship opportunities is also available.

visual services

Supplemental instruction is available using satellite down link, videotape and live transmission to classrooms and dormitories. Also available are state-of-the-art interactive media for computer-based instruction, video production support, digital graphic and photographic products, and self-help video origination and editing. A lending facility provides notebook computers, linear/digital projectors, course videotapes and traditional projection/audio equipment.

classrooms and laboratories

Most classes are in small classrooms. However, some are in the larger, tiered lecture rooms to allow plenty of interactions between students and instructors. There are also large lecture halls for assemblies. In the aeronautics laboratory, you'll use a subsonic continuous wind tunnel, a trisonic blow down tunnel, an F109 high-bypass turbofan engine, a J69 and a J85 operational turbojet engine, a rocket test cell and internal combustion engines. The turbojet engines, which are flown in the T-37 and T-38 trainer aircraft respectively, let you operate the actual engines flown in pilot training.

The Department of Engineering Mechanics' Applied Mechanics Laboratory is one of the most modern and best-equipped undergraduate labs in the country. It provides a wide array of tools and equipment for hands-on learning for class projects and labs. Cadets are encouraged to learn how to use a variety of wood- and metal-working equipment such as a lathe, computer controlled mill, welding equipment, material testing systems and composite material fabrication tools. In addition, a separate garage facility, complete with a full-scale chassis dynamometer, provides a unique opportunity for cadets to apply skills learned in their courses; among many other projects, cadets design and fabricate an off-road vehicle and a formula car for national intercollegiate design competitions.

Three astronautics laboratories contain items unique to an undergraduate school. Workstations with digital and analog computers, facilities for small satellite design, fabrication and testing, rocket design and build-up areas, and high fidelity orbital analysis software support research and classroom activities. Several courses use the engineering division laboratory's metal and wood shops and electronic equipment.

The foreign language learning center includes 97 student workstations plus five teacher PC consoles equipped with VCR/DVD player, digitizing and recording capabilities. The lab uses voice over internet protocol and video on demand technology. Three servers support the interactive and courseware content on the local-area network.
Cadets also study astronomy in the Academy observatory using both 24- and 16-inch telescopes configured with state-of-the-art computer controlled drive systems. Cadets learn how astronomers explore the universe by various detectors: two CCD (Charged Coupled Device) photometers, a photoelectric photometer, a CCD spectrograph and film.

networked classroom laboratory

The Academy's first networked computer laboratory (NCL) was established in 1992. It supports instructors teaching in any academic area, beta testing of operating systems and application software, and hands-on training for faculty and staff. The NCL PCs are upgraded regularly to assure that they are capable of handling new and large software. The Directorate of Education oversees a common-use multimedia laboratory (MML) containing desktop computers, servers, scanners, printers, a copier, a one-gun projector, a binding machine, a laminating machine, drops for laptops, a wireless access point and on-site help. This facility is open seven days a week and operates the same hours as the library. The on-site help is the biggest attraction for students and faculty. In addition to the hardware, the lab computers contain most of the software applications used by the Academy's academic and military training departments. The location, convenience and just-in-time help are not the only advantages of the MML; it is also the perfect technology testing and research environment. It allows technology professionals and instructors to evaluate and test leading-edge educational technology in a controlled environment. The Distance Learning Center (DLC) uses state-of-the-art video teleconferencing equipment and supports a variety of academic courses. Cadets "join" classes at other educational institutions, including other service academies, interact with guest lecturers, and participate in dialogues with students from other colleges and universities. The center also hosts a variety of administrative meetings, saving Academy personnel both time and travel expenses.

computers

Continually updated computer equipment means you'll use one of the finest undergraduate computer centers in existence. A local area network connects every dormitory room, faculty and staff office, classroom and laboratory at the Academy. You'll receive a brand new laptop at the start of your fourth-class year, right after BCT. You will use your computer in virtually every class you take at the Air Force Academy. Consequently, typing skills are a necessity, not a luxury. We strongly recommend that you learn to type at least 25 words per minute accurately prior to your arrival. All hardware and software that you use must be identical, so don't buy your own microcomputer before entering the Academy. We'll bill your pay account, so once your account is paid, the system is yours.

air force academy (mcdermott) library

The library serves your academic, research and recreational reading needs. Professional librarians staff the library 88 hours a week. It maintains over 1.5 million items including: books, national and international journal and newspaper subscriptions, technical reports, an audio collection, and a web page with links to a number of on-line indexes, abstracts and full-text document services. The library's integrated computer system provides access to library holdings and is accessible from all floors of the library, faculty offices and cadet rooms. We recently added wireless capability throughout the library, so you can work online from any location you choose using a notebook computer.

The reference collection contains standard and specialized works on most subject areas. We also provide for electronic searching of selected indexes and access to on-line and CDROM databases that are available to cadets at no cost. You may use U.S. government and international agency documents in the Academy's Documents Depository. Our special collections include major works in aeronautics and military aviation history as well as other documents and papers from distinguished Air Force and military officers.

deficiency and disenrollment

You'll be deficient in academic studies at mid-semester or the end of a semester if any of the following occur: (1) you have a grade of "F" in one or more courses, (2) you have a controllable incomplete ("I") in one or more courses, or (3) your cumulative or semester GPA is less than 2.0.

If you're deficient, an Academic Review Committee (ARC) may recommend you repeat or take a specific course during a subsequent semester, under load one course, change academic majors, take a summer class in place of leave, be turned back to the next succeeding class, or take any other action deemed appropriate. The superintendent will consider the committee's recommendation and make the final decision. If you are seriously deficient, you may face academic disenrollment.

You'll be deficient in military performance if you fail a Professional Competency Exam or if your MPA is below 2.0 at the end of the semester. A Military Review Committee (MRC) evaluates deficient cadets and places them on aptitude probation or starts other corrective action. The committee may recommend that the Academy Board disenroll a cadet seriously deficient in conduct or aptitude for commissioned service.

If you fail one or more items on the Physical Fitness Test (PFT) and have a total score below 250, or if your 1.5-mile aerobics run time is slower than 11:15 (men) or 13:31 (women), you'll be deficient in physical education. You'll also be deficient if you fail any of your physical education instruction. A physical education review committee considers deficient cadets after the final PFT make-up test each semester. The committee may recommend a remedial conditioning program, athletic probation, attendance at a physical education program in place of leave during the summer term, turn back to the next class, or disenrollment.

the faculty

The Academy's faculty is composed of approximately 70 percent Air Force officers and 30 percent civilian professors. A few officers from other branches of the U.S. Armed Forces and from allied nations supplement the faculty, as do several distinguished visiting civilian professors. Unlike most institutions of higher education, the Academy has no graduate students as teachers or laboratory assistants. Each faculty member must possess at least a master's degree, and approximately 50 percent have doctoral degrees. Ten percent of the faculty holds the academic rank of professor; 18 percent associate professor; 44 percent assistant professor; and 28 percent instructor. Faculty members possess degrees from such outstanding colleges and universities as Harvard, Stanford, Yale, Princeton, Duke and the Massachusetts Institute of Technology, as well as from foreign universities such as Kings College-University of London and Oxford University in England.

Faculty members maintain close contact with the cadets, and not just in the classroom. They sponsor extracurricular activities and athletics, and they frequently adopt squadrons and attend their special events. Many contribute to the literature and progress in their fields through research projects. All departments use the talents of their best students in their research efforts. During the summer, faculty members often serve as consultants to other Air Force installations.

divisional and disciplinary majors outlined

We've briefly outlined each major, listing the course sequence. You can find course descriptions throughout this section. As you study these summaries, keep in mind that you must complete all the requirements to major in a subject area. You may change your major if you can meet the new requirements without excessive overloads. If you fulfill all requirements, you may earn more than one major.

aeronautical engineering major

Successful completion of the aeronautical engineering major leads to the degree of Bachelor of Science in aeronautical engineering and prepares cadets for a wide variety of Air Force assignments in research and development, testing and operations in the discipline. The aeronautical engineering major is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 - telephone: (410) 347-7700.

Program operational goals define attributes and capabilities young graduates of the Academy's Aeronautical Engineering Program are expected to exhibit.

The goal of the aeronautical engineering program is to prepare cadets to become leaders of character who:

- Possess breadth of integrated, fundamental knowledge in engineering, basic sciences, social sciences and the humanities; and depth of knowledge in aeronautical engineering.
- Communicate effectively.
- Work effectively on teams and grow into team leaders.
- Are independent learners, and as applicable, are successful in graduate school.
- Can apply their knowledge and skills to solve Air Force engineering problems, both well- and ill-defined.
- Know and practice their ethical, professional and community responsibilities as embodied in the Air Force Core Values.

Upon successful completion of the aeronautical engineering program cadets will demonstrate satisfactory:

- Use of fundamental knowledge to solve aeronautical engineering problems commensurate with a Bachelor of Science degree.
- Ability to plan and execute experimental and computational investigations, and interpret and analyze data from such investigations to formulate sound conclusions.
- Development and evaluation of engineering designs that meet customer needs.
- Use of speaking and writing skills to communicate effectively.
- Ability to work effectively as a member of a multidisciplinary team.
- Skills to engage in independent learning.

In the aeronautical engineering major, studies in aerodynamics, flight mechanics, propulsion, aircraft structures and experimental methods prepare cadets to succeed in either of the two-course design sequences, aircraft design or aircraft engine design.

Suggested Course Sequence:

3rd-Class Year	2nd-Class Year	1st-Class Year
Aero Engr 315	Aero Engr 341	Academy Option A. E. Elective
Chem 200	Aero Engr 342	Aero Design Elective
Econ 201	Aero Engr 351	Aero Engr 442
ECE 231	Aero Engr 352	Aero Engr 471
Engr Mech 220	Aero Engr 361	Aero Engr 481
Law 220	Beh Sci 310	Astro Engr 410
Math 243	English 211	Biology 315
Math 245	Engr Mech 320	English 411
MSS 200	Engr Mech 330	MSS 400
Physics 215	History 302	Philos 310
Pol Sci 211	Math 346	Soc Sci 412
Sys Opt Aero Engr 241	Math 356	Structures Elective

AERONAUTICS (Aero Engr)
Offered by the Department of Aeronautics (IDFAN).

Aero Engr 241. Aero-Thermodynamics. Fundamentals of the 1st and 2nd laws of thermodynamics applied to systems and control volumes. Foundations in heat transfer. Control volume approaches to the equations of motion of a fluid. Applications of gas dynamics to incompressible and compressible flows through nozzles, diffusers and turbomachinery. Isentropic flows to include Prandtl-Meyer expansions, and non-isentropic flows to include normal and oblique shocks, and flows with simple friction and heat transfer. Foundations in engineering problem solving.

Aero Engr 315. Fundamentals of Aeronautics. Introduction to aircraft design, fluid mechanics, airfoil and wing aerodynamics, steady and accelerated aircraft performance, and stability and control. Interdisciplinary design synthesis, analysis and decision-making (including economic, political and other non-technical considerations) of an aircraft to meet a contemporary requirement.

Aero Engr 315Z. Fundamentals of Aeronautics - French language section. Section taught in French; available for students qualified for Aero Engr 315 and having successfully completed or validated French 321; counts as a course for the French language minor and for a major's foreign language requirement. Requires DFF approval.

Aero Engr 341. Aeronautical Fluid Dynamics. Fluid properties, the basic equations of motion: the continuity equation, conservation of linear momentum, and conservation of energy (both the differential and the integral forms). Use of the integral momentum equation to experimentally determine the drag acting on a cylinder in a low-speed stream; spread-sheet computation of unsteady Poiseuille flow; spread-sheet computation of a steady, laminar boundary-layer; turbulent boundary-layer experiment. Stream functions. Potential functions.

Aero Engr 342. Computational Aerodynamics. This course covers the theory and application of modern computational tools used to predict fluid flows around basic and complex geometries. The course is intended to give the student the necessary knowledge to choose the relevant computational tool and perform independent computational analysis of moderately complex geometries. The course will cover grid generation, computational fluid dynamic (CFD) solvers, and post-processing using state-of-the-art tools, as well as computational potential methods such as panel codes or vortex lattice codes. The course is project-oriented and explores the important concepts of temporal and spatial resolution, stability and convergence, and flow-field analysis.

Aero Engr 351. Aircraft Performance and Static Stability. Aircraft force, moment and response definition in various coordinate systems. Takeoff and landing, cruise, climbs, turns and other accelerated performance by both analytic and numerical methods. Static stability and control and related aircraft design considerations.

Aero Engr 352. Aircraft Dynamic Stability and Control. Aircraft equations of motion. Examination of aircraft dynamic modes based on both limited and full degree of freedom models utilizing analytical and numerical methods. Aircraft design considerations. Determination and evaluation of aircraft flying qualities against military specifications. Application of control system theory to the design of aircraft stability augmentation systems and autopilots.

Aero Engr 361. Propulsion I. Introduction to Brayton and jet engine cycles. Application of aero-thermodynamics to aircraft jet engines and major engine components. Overview of the design, performance and applications of turboprops/shafts, turbofans, turbojets, ramjets and scramjets. Focus on preliminary cycle analysis of aircraft gas turbine engines to include mission analysis, parametric cycle analysis and engine performance analysis. Introduction to performance and operating principles of solid and liquid rocket engines.

Aero Engr 436. Aeroelasticity. Aeroelastic phenomena of an aircraft in flight. Dynamic pressure, Mach and angle of attack effects on the bending and twisting of aircraft components. Aeroelastic equations and coefficients related to flight characteristics such as flutter and divergence.

Aero Engr 442. Aerodynamics. Analytical and numerical solution techniques applied to incompressible, compressible, transonic and supersonic flight regimes over airfoils, wings and bodies. Introduction to hypersonic aerodynamics. Techniques include those historically used in incompressible flow up to and including state-of-the-art supersonic solutions using high speed computers.

Aero Engr 446. Introduction to Hypersonics. Analysis of heat transfer and high temperature effects on hypersonic vehicles. Application to reentry and transatmospheric vehicles.

Aero Engr 447. Advanced Applied Aerodynamics. Considers advanced topics in steady and unsteady aerodynamics in all speed ranges for study by analytical, experimental and computational methods.

Aero Engr 456. Flight Test Techniques. Fundamental flight test methods for defining performance and flying qualities characteristic of fixed wing aircraft. Patterned after the Flight Test Engineer's Course at the Air Force Test Pilot School. Students fly in designated aircraft to obtain flight test data.

Aero Engr 456L. Flight Test Techniques Laboratory. Application of fundamental flight test methods for defining the performance and flying qualities characteristic of high performance fixed wing aircraft. This laboratory experience serves as a final project for Aero Engr 456. Students receive credit by participating in a field trip to Edwards AFB, a flight test sortie in a high performance aircraft, creation of a written report, and presentation of a final briefing. Scheduled during the same class period as Aero Engr 456.

Aero Engr 457. Aircraft Feedback Control Systems. Design and analysis of aircraft stability augmentation and automatic flight control systems by classical root locus and frequency domain techniques. Introduction to digital system analysis. Analytical and numerical methods complemented with aircraft simulation.

Aero Engr 466. Propulsion II. Analysis of advanced aircraft engines. Preliminary aerodynamic and structural design of major engine components including inlets, compressors, combustors, turbines, mixers, afterburners and nozzles.

Aero Engr 471. Aeronautics Laboratory. Introduction to experimental methods and techniques. Introduction to instrumentation and data acquisition systems. Statistical analysis of data. Selected experiments in the fields of aerodynamics, gas dynamics, propulsion and flight mechanics.

Aero Engr 472. Advanced Computational Aerodynamics. Advanced theory and application of computational tools used to predict and analyze fluid flows of interest supporting Air Force research, development, test and evaluation programs. Working in teams, students gain the necessary knowledge and background to make contributions using the DOD's High Performance Computing (HPC) Modernization Program resources. Projects include investigation of unsteady flows, boundary layers, turbulence models, shocks and multi-physics simulations.

Aero Engr 481. Introduction to Aircraft and Propulsion System Design. Fundamentals of aircraft and propulsion system design taught using a systems engineering approach. Aerodynamic design and drag prediction. Parameter effects on constraint analyses and preliminary weight estimation. Configuration optimization. Conceptual layout and preliminary analysis of aircraft structures. Factor and margin of safety. Material selection including strength, stiffness, weight and cost considerations. Introduction to propulsion system design and selection criteria. Safety, reliability, maintainability, schedule and cost management concerns are addressed.

Aero Engr 482. Aircraft Design. Design of an aircraft using a systems engineering approach to meet specifications provided. Detailed configuration optimization, aerodynamic analysis, structural layout, material selection, and structural component sizing, weight and center of gravity analysis, and stability and control analysis. Safety, reliability, maintainability, schedule and cost management concerns are addressed.

Aero Engr 483. Aircraft Engine Design. Preliminary design of an aircraft engine to meet specified performance requirements. Cycle selection, installation effects and engine sizing. Determination of installed and uninstalled performance of selected and sized engine. Preliminary design of major engine components to include variable geometry inlets, fans, compressor, main burner, turbine, afterburner and exhaust nozzles. Material selection for each component is accomplished based on criteria such as the stress and temperature environments, manufacturability, radar absorption capability, weight, and cost. Safety, reliability and maintainability concerns during the design process are addressed throughout the course. Course includes, if possible, a voluntary field trip to a government/industry design facility.

Aero Engr 495. Special Topics. Selected topics in aeronautical engineering.

Aero Engr 499. Independent Study. Individual study and research supervised by a faculty member. Topic established with the department head.

astronautical engineering major

A major in astronautical engineering is the broad application of science and engineering to aerospace operations. Special emphasis is placed on astrodynamics, aerospace systems design and control systems. Thus, the student is prepared for Air Force duty with specialization in research, design, development and analysis of space technology and aerospace avionics. Students successfully completing this major are awarded the degree of Bachelor of Science in astronautical engineering, which is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 - telephone: (410) 347-7700.

The goal of the astronautical engineering program is to prepare cadets to become leaders of character who:

- Possess a breadth of integrated, fundamental knowledge in engineering, basic sciences, social sciences and humanities; and depth of fundamental knowledge in astronautical engineering.
- Can communicate effectively.
- Work effectively with others, work as team members, and grow into team leaders.
- Are committed to life-long learning.
- Can apply their knowledge and skills to frame and solve Air Force engineering problems, both well- and ill-defined.
- Know and practice their ethical and professional responsibilities as embodied in the Air Force Core Values.

Upon successful completion of the Academy's Astronautical Engineering program students will have the ability to:

- Use fundamental knowledge of orbital mechanics, space environment, attitude determination and control, telecommunications, space structures and rocket propulsion to solve astronautical engineering problems including engineering design.
- Plan and execute experimental studies and formulate sound conclusions, analyzing empirical data.
- Apply modern technology tools to solve astronautical engineering problems.
- Communicate effectively using oral, written, graphical and electronic formats.
- Recognize the ethical and professional responsibilities of Air Force officership and the engineering profession.
- Work effectively as a member of a multi-disciplinary team.
- Recognize the benefits of and possess the skills needed to engage in life-long learning.
- Informatively discuss the impact of engineering on present-day societal and global contemporary issues including Air Force aerospace capabilities and requirements.

Suggested Course Sequence:

3rd-Class Year	2nd-Class Year	1st-Class Year
Astro Engr 201	Astro Engr 321	Acad Opt Depth Opt
Astro Engr 210	Astro Engr 331	Aero Engr 315
Chem 200	Astro Engr 351	Astro Engr 445
ECE 231	Beh Sci 310	Astro S E Design Opt 1
English 211	Econ 201	Astro S E Design Opt 2
Engr Mech 220	Engr 341	Biology 315
Engr Mech 320	Engr 342	ECE 446
Law 220	Engr Mech 330	English 411
Math 243	History 302	MSS 400
Math 245	Math 346	Philos 310
MSS 200	Math 356	Soc Sci 412
Physics 215	Pol Sci 211	Space Environment Opt
Sys Opt Aero Engr 241		

ASTRONAUTICS (Astro Engr)
Offered by the Department of Astronautics (DFAS).

Astro Engr 201. Technology Skills for Astronautics. Self-paced course designed to provide the programming, modeling and simulation skills required in the various courses in the astronautical engineering major. Students are introduced to the MatLabTM/SimulinkTM tools for programming, modeling and simulation and to state-of-the-art 3-D computer tools for satellite analysis and visualization. A series of proficiency tasks must be completed using the various tools over the course of the semester.

Astro Engr 210. Introduction to Astronautics. Introduction to the history, principles and challenges of space. Examines elements of space missions including orbits, spacecraft systems, launch vehicles, re-entry, operations and mission management. Emphasis on understanding the underlying physical principles and the system engineering process used to select orbits, plan maneuvers, and accomplish preliminary design of spacecraft payloads/subsystems to meet mission requirements. Reinforces concepts through hands-on use of application-based analysis and visualization software and communication of learned principles through written reports. Intended for students who have or are considering declaring the astronautical engineering or space operations majors. Course content is identical to Astro Engr 410; but with additional emphasis placed on mathematical background of the material in preparation for students interested in pursuing those majors.

Astro Engr 321. Intermediate Astrodynamics. Intermediate course in orbit mechanics. Topics include orbit determination and prediction, orbit maneuvers, perturbations, rendezvous and proximity operations. Emphasizes the design and use of structured computer programs to solve real-world astrodynamics problems. Programming experience is recommended.

Astro Engr 331. Space Systems Engineering. Presents fundamentals of space vehicle design with an emphasis on systems engineering. Introduces system-level spacecraft design issues including reliability, environments, radiation effects, testing, materials engineering, integration, launch vehicles and operations. Introduces and analyzes payloads, structures, propulsion, electrical power, communications and data handling, attitude determination and control, and thermal control subsystems. Includes an integrated lab experience where small teams analyze and integrate subsystems into a functioning small satellite called "EyeasSat." Teams demonstrate and document their EyeasSat at the system level as a part of the final evaluation.

Astro Engr 351. Rocket Propulsion. Introduces rocket propulsion and propulsion system design. Uses the basic laws of thermodynamics, thermochemistry and conservation to determine ideal motor performance. Emphasis on describing the components and conceptual design criteria for liquid, solid and hybrid rockets. Also studies electric, nuclear and other advanced propulsions systems.

Astro Engr 410. Introduction to Astronautics. Introduces the history, principles and challenges of space. Examines elements of space missions including orbits, spacecraft systems, launch vehicles, re-entry, operations and mission management. Emphasizes understanding the underlying physical principles and the system engineering process used to select orbits, plan maneuvers, and accomplish preliminary design of spacecraft payloads/subsystems to meet mission requirements. Reinforces concepts through hands on use of application-based analysis and visualization software and communication of these learned principles through written reports.

Astro Engr 422. Advanced Astrodynamics. Continuation of Astro Engr 321, focuses on applying numerical and analytical techniques to solve realistic Air Force problems in astrodynamics and space operations. Perturbations and the associated effects on satellite orbits are examined. Applies Least Squares and Kalman filter estimation techniques to the orbital prediction problem using batch and sequential processing. Uses structured computer programming extensively in problem solutions.

Astro Engr 423. Space Mission Design. Examines basic mission design principles for Air Force and civilian launch systems. Studies mission objectives and constraints; feasibility studies; time-line generation; launch, on-orbit and recovery operations; and contingency planning. Applies structured computer programming to analyze typical space missions.

Astro Engr 436. Small Spacecraft Engineering I. Introduction to small satellite systems engineering. Multi-disciplinary system design of spacecraft hardware and software to include subsystems, payloads and ground stations. Define mission and system requirements, perform engineering trade studies, design and analyze spacecraft systems.

Astro Engr 437. Small Spacecraft Engineering II. A second course in small satellite systems engineering. Multi-disciplinary system design and fabrication of spacecraft hardware and software to include subsystems, payloads and ground stations. Finalize design, fabricate, test and fly actual spacecraft on space boosters.

Astro Engr 445. Spacecraft Attitude Dynamics and Control. Fundamental introduction to the problem of controlling satellite attitude. Topics include direction cosine and Euler angle attitude parameters, torque-free rigid body motion, flexible body effects and energy dissipation, spin stabilization, gravity-gradient stabilization, momentum and reaction wheel control, and reaction jet control. Projects include the development of a satellite attitude dynamics simulation and the design of a reaction wheel and reaction jet attitude control system. Includes analysis and synthesis with MATLAB™ simulation.

Astro Engr 446. Space Navigation. Inertial navigation including studies of the accelerometers and gyroscopes used in strap down platforms, system mechanization, navigation equation development and system error analysis. Non-inertial navigation including studies of Global Positioning System (GPS), star trackers, and other position, velocity, and attitude sensors. Aided navigation methods using least squares and optimal estimation techniques. Projects include simulation of solid state optical gyros and development of an aided navigation algorithm. For students enrolled in both Astro Engr 445 and Astro Engr 446 the suggested sequence is Astro Engr 445 first, followed by Astro Engr 446.

Astro Engr 452. Rocket Engineering I. Introduces rocket systems engineering. Design, fabrication and operational testing of aerospace vehicle systems and subsystems. Students design, build and launch a sounding rocket with instrumented payloads using systems engineering design techniques. Relies on analysis and synthesis tools and techniques developed previously in the areas of structures, dynamics, propulsion, control, instrumentation and computer simulation.

Astro Engr 453. Rocket Engineering II. A second course in rocket systems engineering.

Astro Engr 495. Special Topics. Selected topics in astronautics.

Astro Engr 499. Independent Study. Individual study and research supervised by a faculty member. Topic established with the department head.

Astro Engr 543. Methods of Optimization for Engineers. Teaches optimization methods at graduate level. Topics include parameter optimization, optimization for dynamic systems, optimal control and numerical solutions.

basic sciences major

The basic sciences major is a divisional major incorporating the basic sciences of biology, chemistry, computer science, mathematics and physics. This divisional program is recommended for students wishing to major in the sciences but preferring a broad, flexible curriculum with a high degree of individual choice. This program is also a sensible alternative for students already declared in either a basic sciences or engineering disciplinary major who, for a variety of reasons, find the divisional approach more suited to fulfilling graduation requirements.

Since this major lacks the structure of a disciplinary major, students wishing to go to graduate school in a science field should pay particular attention to course selection, or they will most likely be required to take additional undergraduate courses in the selected discipline prior to entering graduate school.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Bas Sci Opt 1	Aero Engr 315	Academic Div Opt
Bas Sci Opt 2	Bas Sci Opt 5	Academic Div Opt
Bas Sci Opt 3	Bas Sci Opt 6	Academic Div Opt
Bas Sci Opt 4	Bas Sci Opt 7	Academy Opt
Chem 200	Bas Sci Opt 8	Astro Engr 410
Econ 201	Beh Sci 310	Bas Sci Opt 9
English 211	Biology 315	English 411
Engr Mech 220	ECE 315	Mgt 400
Law 220	History 302	MSS 400
MSS 200	Math 300/356/378	Soc Sci 412
Physics 215	Philos 310	
Pol Sci 211	S/T Energy Sys Opt	

behavioral sciences major

No matter what you do in life, there is one irrefutable fact; you'll be working with other people. Therefore, your success in any field will depend largely on your understanding of yourself and others and your ability to work together. The behavioral sciences major lays the foundation for this understanding. Three academic options are offered in the major: leadership studies option, which examines in depth the behavioral sciences approach to studying and developing leadership; human factors and systems design option, which focuses on how people interact with the machines and systems they use; and the behavioral sciences option, which allows students the opportunity choose a diverse menu of courses to tailor their course of study to individual professional and educational goals. All three options require the completion of the core, two additional foreign language courses, plus 12 major's courses for a total of 147 semester hours.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Beh Sci 231	Aero Engr 315	Academy Opt
Beh Sci Course	Beh Sci 310	Astro Engr 410
Chem 200	Beh Sci 332	Beh Sci Course
Econ 201	Beh Sci Course	Beh Sci Course
English 211	Beh Sci Course	Beh Sci Course
Engr Mech 220	Beh Sci Course	Beh Sci Course
For Lang 3	Beh Sci Course	Beh Sci Course
For Lang 4	Biology 315	English 411
Law 220	ECE 315	Mgt 400
MSS 200	History 302	MSS 400
Physics 215	Math 300	Soc Sci 412
Pol Sci 211	Philos 310	S/T Energy Sys Opt

BEHAVIORAL SCIENCES (Beh Sci)
Offered by the Department of Behavioral Sciences and Leadership (DFBL).

Beh Sci 110. Introduction to Behavioral Sciences. Provides an introduction to the scientific study of behavior and mental processes across diverse levels of analyses. Covers psychological principles that can be applied in and out of the military. Critical thinking, leadership and respect for human dignity is emphasized through the study of subjects such as perception, cognition, learning, memory, social interactions, mental health issues and the biological basis of behavior. In addition, students will be exposed to subjects closely related to psychology such as sociology, cultural anthropology, leadership and human factors engineering.

Beh Sci 231. Basic Research Methods and Statistical Tools. Introduces the integrated approach to statistics and empirical research. Topics include basic research design, APA statistical reporting, SPSS data analysis, descriptive measures, inferential statistics and hypothesis testing.

Beh Sci 310. Foundations for Leadership Development. Explores leadership development through both academic study and applied exercises. Specifically, it examines individual leader development principles that will set students on a lifelong path to becoming leaders of character who treat others with respect and dignity. Combines the academic study of leadership development with experiential exercises, case studies and student projects designed to help students develop in their own leadership capacity.

Beh Sci 311. Team and Group Dynamics. Students sharpen the skills and understanding necessary to work effectively in groups and teams through case study analysis, collaborative projects and group discussions. Students investigate and apply course concepts to challenges such as peer leadership, authority, roles and perceptions, motivation and interpersonal dynamics.

Beh Sci 330. Abnormal Psychology. Examines the development, nature and treatment of psychological disorders within a biopsychosocial context. Special consideration is given toward leadership and military applications.

Beh Sci 332. Advanced Research Methods and Statistical Tools. Continues the integrated approach to statistical and experimental psychology, extending student experience into practical experimental design; methodological procedures are learned and applied in psychology and human factors experiments.

Beh Sci 335. Learning and Memory. How does experience affect performance? This is the central question that has confronted learning theorists for several millennia; it is a question that dominated psychology for most of its first century. This course examines learning and memory from a variety of historical theoretical perspectives. In the laboratory students will test learning and memory notions using rats and then report their experimental findings.

Beh Sci 352. Social Psychology. Provides an introduction to social psychology and behavioral sciences. Social psychologists seek to understand the nature and causes of individual behavior in social situations. In other words, social psychology explains how the average person reacts to various social pressures. Topics covered include social perception, attitudes, prejudice and discrimination, interpersonal attraction, social influence, pro-social behavior, aggression, groups and personality. From a practical standpoint, this course explains how and why people react to the world and other people as they do. Leadership implications are discussed.

Beh Sci 355. Biopsychology. Examines the biological and neurophysiological foundations of human and animal behavior. Emphasizes central nervous system mechanisms, which mediate processes such as learning and memory, language, intelligence, sleep and arousal, reward and punishment, and human mental disorders. Gives special consideration to sensation and perception and topics that impact human factors design concerns.

Beh Sci 358. Military and Society. Introduces sociology's foundational perspectives and focuses on a subfield in sociology known as military sociology. Applies theoretical thinking and empirical findings from the social sciences to the military, both as bureaucracy and as a profession. Includes issues on how militaries are put together, how individuals fit into them, how militaries are related to the societies and cultures in which they are located, and the extent to which these processes are the same or different in all societies. While the primary emphasis is upon the American military, it also considers other armed forces and their respective societies.

Beh Sci 360. Sociology. Introduces sociology's foundational perspectives and methodologies and applies them to the systematic study of human behavior in social contexts. Basic topics include the "sociological imagination," biology and social behavior, the origins and components of culture, socialization, the structure of social interaction, and the creation and maintenance of groups, organizations and societies. Additional themes include social stratification, race/ethnicity, gender and sexuality, globalization and development, marriage and family, religion and social change.

Beh Sci 361. Social Problems, Issues and Controversies. Builds on foundational sociological perspectives and methodologies to extend the concepts of social order, social control, disorder and deviance. Applies these theoretical foundations to the study of contemporary problems and issues such as globalization, population dynamics, crime and delinquency, sexuality controversies, evolving family structures and so on.

Beh Sci 362. Class, Race and Gender. Builds on foundational sociological perspectives and methodologies to define and analyze dimensions of social stratification. Examines the central elements of class stratification – wealth, power and prestige – considers theories related to dominant-subordinate group relations, provides a treatment of current social conditions of racial/ethnic groups in the U.S., and analyzes the construction and reinforcement of gender and sexuality within major institutions in American society.

Beh Sci 370. Cognitive Psychology. Familiarizes students with the cognitive approach to understanding human behavior which argues that human behavior can best be understood and predicted through a scientific understanding of mental activity. Topics include: perception, attention, memory, decision-making, consciousness and other processes related to thinking.

Beh Sci 373. Introduction to Human Factors. Examines the process, principles and guidelines of human factors as they impact the design of systems used by people and provides an introduction to human factors engineering and systems design. Emphasizes interactions between human capabilities and limitations, to the task, and the environment, as they relate to system performance.

Beh Sci 375. Human Factors in Aviation Systems Engineering. Examines human performance and human-machine design issues in military and civilian aviation systems. Students learn about human factors engineering in aviation systems and their failures as well as reviewing the nature and scope of human factors impacts on performance by air and ground crews and their supervisors. Reviews the body of knowledge demonstrating how human flight-related performance is based on psychological and physiological capabilities and limitations that, in turn, influence humans' abilities to interact within the systems design constraints. Students also learn how the application of effective systems design, specialized automation and ongoing training can facilitate optimal human-system performance associated with flight.

Beh Sci 380. Theories of Personality. Examines major psychological theories of personality including analytic, humanistic, cognitive and learning approaches. Considers other non-traditional approaches which explain personality development from the socio-cultural perspective. Examines theoretical concepts to understand individual personality development, relevant current and historical issues, and application to military leadership.

Beh Sci 390. Sensation and Perception. Provides an introduction to the way the outside world is perceived through our senses and how our brain makes sense of all the sensory inputs. How our body experiences the world and what we perceive of the world are two interrelated, but different entities. This is an important topic for Air Force officers, because our perceptions do not always accurately represent the outside world. For example, pilots with inaccurate perceptions of their aircraft attitude (e.g., spatial disorientation) could lead to loss of control of their aircraft. Through lectures, labs, demonstrations and discussions, this course introduces the basic anatomy of the sensory systems, as well as how these structures are used to "make sense" out of what we are experiencing so that we can do such things as understand speech, perceive color, see motion and depth, and recognize faces.

Beh Sci 411. Contemporary Leadership Theory and Practice. Explores the current trends and theories in leadership and leadership development from a scientific perspective, centering on the substantiated and promising concepts of transformational leadership, values-based leadership, servant leadership and emotional intelligence, among others. Case studies/current events, facilitated and student-led round-table discussion projects and experiential exercises allows students to gain an in-depth understanding of leadership and its application across a variety of situations and contexts.

Beh Sci 412. Leading and Measuring Organizational and Personal Change. The purpose of this course is to enhance understanding of the tools, process and challenges of effective change. Students learn basic assessment procedures and their application to leading organizational and personal change. Focuses on change theory, processes and models including the role of change agents, personal and organizational diagnosis and intervention, problems and issues in organizational change, and job analysis and performance.

Beh Sci 430. Tests and Measurement. Provides a basic understanding of the field of testing and measurement. Discusses the terminology, procedures and basic psychometric properties inherent in assessment procedures. Introduces various types of assessment instruments. Focuses on understanding individual and organizational assessment through an overview of measurement principles, the assessment process, test construction and development, and the use of evaluation results. Presents students the opportunity to learn and apply test construction through the development of assessment instruments. As this is an overview course, students will not gain proficiency in administering clinical assessment instruments.

Beh Sci 440. Lifespan Development. Examines how people develop physically, psychologically, socially and cognitively from birth to death. Explores changes that are universal and changes that are unique to specific individuals. Presents developmental theories explaining these changes. Focuses on the social context of development: "What is the impact of income, education, ethnicity, race, sex, culture and historical time period on developmental outcomes?"

Beh Sci 450. Advanced Topics in Leadership. An advanced course designed to explore critical topics in leadership on a rotational basis to create a deeper and more robust understanding of the specific discipline. Particular course content and emphasis varies from year to year based on new and emerging research in the selected field of study. Designed primarily for the advanced student and is conducted through a seminar/discussion model. A student may only take this course once.

Beh Sci 460. Advanced Topics in Sociology. An advanced course exploring specialized topics in sociology on a rotational basis with the intent of creating a deeper and more robust understanding of the specific discipline. Particular course content and emphasis varies from year to year based on new and emerging research in the selected field of study. Designed primarily for the advanced student and is conducted through a seminar/discussion model.

Beh Sci 470. Advanced Topics in Cognitive and Bio-Psychology. Advanced course designed to explore specialized topics in cognitive and bio-psychology on a rotational basis with the intent of creating a deeper and more robust understanding of the specific discipline. Particular course content and emphasis varies from year to year based on new and emerging research in the selected field of study. Designed primarily for the advanced student and is conducted through a seminar/discussion model.

Beh Sci 471. Engineering Psychology. Advanced course examining cognitive and human performance theories and their applications to human-machine integration in systems design. Special attention is given to the way humans perceive, understand and respond to the information. Application of course content includes the development of an experimental setting to test an applied research question.

Beh Sci 472. Human-Computer Interaction. Surveys human-computer interaction concepts, theory and practice. Implements an interdisciplinary approach with emphasis on usability methods and the user-interaction-development process. Covers iterative development of user interaction design including user requirements gathering, task analysis, design, prototyping and evaluation. Emphasizes communications between users and system developers. Iterative hands-on development activities are practiced in the context of several team projects.

Beh Sci 473. Human Factors Engineering in Systems Design. This capstone course emphasizes the role and responsibilities of the human factors engineer in the design and evaluation of systems. Uses a combination of group, individual and in-class design projects to explore the system design process. Gives particular attention to human characteristics and their effects on system performance.

Beh Sci 480. Advanced Topics in Personality and Social Psychology. Advanced course designed to explore specialized topics in personality and social psychology on a rotational basis with the intent of creating a deeper and more robust understanding of the specific discipline. Particular course content and emphasis varies from year to year based on new and emerging research in the selected field of study. Designed primarily for the advanced student and is conducted through a seminar/discussion model.

Beh Sci 490. Counseling Theory and Skills For Leaders. Integrates material learned in other behavioral sciences courses and covers relevant counseling theories and models. Emphasizes techniques relevant to military leadership counseling applications, such as: crisis intervention skills, solution-focused treatment, combat stress approaches and critical incident stress debriefing methods.

Beh Sci 495. Special Topics. Selected topics in the behavioral sciences.

Beh Sci 499. Independent Study. Research or practicum in a specific area of behavioral science. Conducted on a tutorial basis.

biology major

Are you interested in what makes your body function? Are you fascinated by the vast diversity of living organisms on this planet? Does the idea of decoding a strand of DNA interest you? If so, then the biology major is for you. This major is designed to promote the development of the student's natural scientific talents through a carefully planned program of academic instruction, practical laboratory experience and individual research projects.

The biology major provides a multidisciplinary approach to the study of human performance in air and space, exercise, biomechanics, environmental sciences, and cutting-edge cell and genetic engineering. Some students pursue specialized areas of interest such as aviation and flight, human factors in aviation and space, athletics and sports performance, ecology, cell and molecular biology, or professional or advanced degree preparation.

The biology major is also very flexible, students are not limited to a specific area of study and are free to tailor a program to meet their own interests. The biology major can complement many careers in the Air Force or prepare you for a career in the health professions (such as medicine or dentistry) or in the Biomedical Sciences Corps (including aerospace physiology, bioenvironmental engineering and physical therapy).

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Biology 210	Aero Engr 315	Academy Opt
Biology 330	Beh Sci 310	Astro Engr 410
Chem 230	Biology 331	Biology 380
Econ 201	Biology 332	Biology 480
English 211	Biology 360	Biology Opt 2
Engr Mech 220	Biology 363	Biology Opt 3
Law 220	Biology Opt 1	English 411
MSS 200	ECE 315	Human Phys Opt
Physics 110	History 302	Mgt 400
Physics 215	Math 356	MSS 400
Pol Sci 211	Philos 310	Sci Breadth Opt 2
S/T Energy Sys Opt	Sci Breadth Opt 1	Soc Sci 412

BIOLOGY (Biology)
Offered by the Department of Biology (DFB).

Biology 210. Paradigms in Biology with Laboratory. Establishes a foundation for further study in the biological sciences. It is required for biology majors and recommended for those pursuing advanced courses in biology (e.g., students pursuing careers in the Medical, Dental, Nursing and Biomedical Sciences Corps). Biology 210 serves as a core substitute for Biology 315. Presents the concepts essential for understanding modern biology. Course content includes: cell biology, metabolism, genetics, biotechnology and evolution. Discussions address application and limitations of the scientific method, ethical issues of modern biology, and the influence of biological science on society. Laboratories reinforce concepts, promote critical thinking and introduce essential laboratory skills.

Biology 315. Introductory Biology with Laboratory. Provides an overview of biological systems, their structure and function, covering concepts essential to understanding key issues in biology today. Students learn how biological systems are organized and operate throughout the biological hierarchy. Decision-making based on an understanding of biological systems is applied to Air Force operations and to the health and fitness of the Air Force officer. Concepts are reinforced through critical thinking exercises, hands-on activities and laboratory experiences.

Biology 320. Biomechanics. Studies the physical, anatomical, mechanical and physiological basis for motion focused on the human. Explores joint and muscle physiology as a basis for functional activities. Applies physics and mechanical engineering concepts to describe, investigate and compare the ways we initiate and control movement. Students learn the effects musculoskeletal injury may have on normal motion.

Biology 330. Zoology. Integrated study of the principles of invertebrate and vertebrate zoology presented with a phylogenetic approach. Examines the behavior, ecology, morphology, physiology, reproductive biology, classification and evolutionary relationships of animals. Functional aspects of respiration, circulation, osmoregulation, excretion, metabolism and thermoregulation are highlighted through comparisons within and among animal groups. Through laboratory exercises students will learn and recognize structural, physiological and evolutionary features of selected animals.

Biology 331. Botany. Integrated study of the biology of plants is presented from molecular to community levels of organization. Course content is organized into five units of the study: the plant system, plant anatomy and morphology, plant physiological ecology, plant reproductive biology, and plant evolution and classification. Although the focus is primarily on seed plants, other organisms such as fungi, algae and lichens are explored. The study of plants is important because of their relevance to nutrition, drugs, celebration, and objects from daily life such as paper products, clothing, furniture and flowers. A botanical perspective enriches an understanding of the natural world. Laboratory and fieldwork is required.

Biology 332. Microbial Diversity. Microscopic organisms are intimately involved in our daily lives, where they produce many familiar foods and medicines, impact health, and play important roles in natural and engineered systems. This course will survey microbial groups that include algae, bacteria, fungi, protozoa, viruses, viroids, prions and selected invertebrates. Each group will be considered in terms of structure, classification, biochemistry, ecology, and economic and medical significance. Relevance to the Air Force mission, such as deployment health issues and biowarfare defense, is reinforced throughout the course. Includes integrated labs and demonstrations.

Biology 345. Aerospace Physiology. Provides in-depth knowledge as to how human performance relates to the warrior and aircrew member. Specifically, it includes a survey of the physiological stresses associated with the aerospace environment. Topics include: effects of pressure changes with altitude, hyperbaric environments, respiratory and circulatory physiology, hypoxia and hyperventilation, pressurization and aircraft decompression, effects of "G" forces, self-imposed stresses, thermal stresses, human factors, crash dynamics and escape systems, sensory physiology, spatial disorientation and space physiology. Suitable for cadets majoring in any academic discipline, including the divisional majors or other programs.

Biology 360. Cell and Molecular Biology. Comprehensive examination of the cell, the fundamental unit of life. Emphasis on eukaryotic cells, cellular organization and processes, and how cell structure and activity ultimately determine structures and functions at the organismal level. Lesson topics include but are not limited to major cell structures, energy transforming cellular processes, application of cell biology to human disease, the cell cycle and biotechnology. Fundamental cellular concepts will be illustrated and reinforced through discussions of factual information applied to case studies and critical thinking exercises. Reinforces current principles of cell biology and facilitates learning of the scientific method.

Biology 363. Genetics. Introductory course in classical and contemporary genetics explores a variety of topics, processes and issues, including simple (Mendelian) and complex inheritance patterns, genetic mapping, sex determination, population/evolutionary genetics, DNA/RNA biochemistry/function, genome structure, DNA replication, gene expression, mutations, genetic/chromosomal disorders, forensics and genetic engineering. The ethical and social issues that emerge from modern genetics are discussed, and the relevance of the lesson material in personal, clinical and military contexts is emphasized. Laboratory and practical exercises complement the content and provide hands-on experience with classical and modern techniques used in generic research and biotechnology. Group laboratory project reinforces concepts, provides experience with live organisms, and develops skills in problem solving, critical thinking, scientific writing and effective teamwork.

Biology 370. Human Nutrition. Provides a comprehensive, thoroughly updated account of nutrition principles and their application. Furnishes students with accurate nutrition information and teaches them how to use a critical-thinking approach in making important daily decisions about their own diet. Focuses on the fundamentals of nutrition such as defining the roles of carbohydrates, fats, proteins, vitamins and minerals in metabolism; examining eating practices through individual dietary analysis, exploring the importance of nutrition in the prevention of disease; and discussing the interplay of diet options with various body systems for athletic performance, daily fitness and overall health.

Biology 380. Principles of Ecology. Fundamental interrelationships between organisms and their environments, emphasizing energy flow through ecosystems, biogeochemical cycling, population dynamics and community interactions. Emphasis on how human activities affect the quality of life and the natural world. Case studies include the impact of environmental concerns on regional and global Air Force operations.

Biology 410. Anatomy and Physiology: Sensory and Motor Integration. Introduction to human sensory and locomotory systems via experimentation and dissection of the human cadaver, with dissection emphasized. Focuses on feedback mechanisms and the integration of organ systems for homeostasis and voluntary control.

Biology 430. Vertebrate Zoology. Studies evolutionary origins, adaptations, characteristics, natural history and classification of five major vertebrate groups: Fishes, Reptiles, Amphibians, Mammals and Birds.

Biology 431. Microbiology. Studies classical microbiology to include: environmental, industrial and medical applications. Laboratory studies to complement lectures. Systematics and classification of bacteria and viruses; the structure, function and metabolic pathways of groups of bacteria. Microbial ecology of humans; disease processes and defense. Microbiology of waste disposal, waste treatment, environmental microbiology, and industrial microbiology, biowarfare and bioterrorism.

Biology 440. Anatomy and Physiology: Visceral Systems Integration. Introduction to systems physiology via experimentation and dissection of the human cadaver, with experimentation emphasized. Focuses on neural and endocrine feedback mechanisms for involuntary control and maintenance of homeostasis.

Biology 459. Principles of Evolution. Examines the principles, patterns, mechanisms and processes of biological evolution. The course format is comprised of traditional lectures, student-led discussions, guest speakers, practical exercises, video programs and selected readings. The course draws on examples from botany, zoology, human anatomy, cell and molecular biology, ecology and genetics to provide a fuller understanding of evolution in terms of evidence, processes and outcomes. Through the study of evolutionary biology, students gain an appreciation of evolution as a unifying theme in biology and acquire a more complete understanding of the origins, diversity, interrelationships, geographical distributions and adaptations of living organisms.

Biology 464. Molecular Biology Methods. Practical study of the methods and techniques used in the modern molecular biology and genetic engineering laboratory. Instructor-assisted laboratory exercises with complementary lectures focus on bacterial genetics, preparation and analysis of nucleic acids, recombinant DNA construction, bacterial transformation, analysis of cloned gene products, chromatographic separation of biomolecules and polymerase chain reaction applications. Selected methods used in cancer, immunology and animal development research are included.

Biology 480. Biology Capstone Seminar. The Biology Capstone Seminar emphasizes student participation in exploring a variety of current biological issues. Students are challenged to develop a deep, reflective understanding of a wide range of biological concepts as they evaluate evidence, analyze issues, clarify assumptions and consider different perspectives. They communicate clear logical, scientific thinking through reading, listening, speaking and writing.

Biology 481. Applied Ecology. Lecture and laboratories addressing ecology and field biology. Lecture includes biotic and abiotic inputs and controls of various ecosystems. Laboratory exercises introduce survey techniques used in field studies. Classroom and laboratory work emphasizes environmental issues that are of special interest to Air Force personnel. Includes field studies conducted on the Academy grounds.

Biology 486. Principles of Chemical, Biological, Radiological and Nuclear (CBRN) Warfare Defense. Covers the historical and contemporary use of CBRN weapons in state-sponsored warfare and terrorism. Mechanisms and biological effects of CBRN agents/weapons will be discussed. Topics include various employment considerations for use of CBRN warfare agents and weapons, from state-sponsored to terrorist use, and examine methods used for CBRN detection and identification. The current state of the CBRN defense community, including warfighters, first responders, medical responders and the intelligence community are also evaluated.

Biology 495. Special Topics. Selected topics in the biological sciences.

Biology 499. Independent Study. Individual research or tutorial study in the biological sciences under the direction of a faculty member. Emphasis is on using pertinent biological literature and conducting laboratory research.

chemistry major

From developing the materials employed in the F-22 to understanding space sensor and satellite technology to analyzing chemical and biological warfare data, chemistry is at the forefront of Air Force research. The majors in chemistry are recommended for those who are interested in chemical or biochemical research or applications. They provide fundamental knowledge in analytical, biological, inorganic, organic and physical chemistry and allow the student to select a specialized degree track for in-depth study. The majors in chemistry emphasize the use of the laboratory methods for reinforcement of lecture material and individual research projects. All three majors prepare students for a junior officer position in research, development or graduate training. A junior officer may be assigned to Air Force labs such as the High Explosive Research and Development Facility (HERD) or the Directed Energy Lab. Additionally, students graduating with one of the chemistry majors are very competitive for medical school, dental school, bioenvironmental engineering, pilot, navigator, aircraft maintenance, intelligence and a host of other operational and support career fields.

Chemistry Option
The chemistry option is the most flexible one offered by the Department of Chemistry, allowing a broader spectrum of in-depth studies.

Biochemistry Option
Biochemistry investigates the rapidly changing arena where chemistry, biochemistry, and molecular and cell biology interrelate. This provides an excellent foundation in the sciences for those interested in medical school or research fields, such as medicinal chemistry, biopolymers, biosensors and nanoscience.

Materials Chemistry Option
Materials chemistry is an interdisciplinary program designed to meet the Air Force's need for qualified personnel with an understanding of modern materials, such as composites, ceramics, polymers, alloys, semiconductors and superconductors. It bridges the gap between designing and developing materials at the molecular level and the physical application of these materials at the macro level for structural, electronic and optical uses.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 222 (All)	Aero Engr 315 (All)	Academy Opt Chem 492 (BioChem)
Chem 236 (All)	Beh Sci 310 (All)	Academy Opt Chem 499 (Chem/Mat)
Econ 201 (All)	Biology 315 (All)	Astro Engr 410 (All)
English 211 (All)	Biology Opt 1 (BioChem)	Biology Opt 2 (BioChem)
Engr Mech 220 (All)	Chem 333 (All)	Chem 431 (All)
Law 220 (All)	Chem 334 (All)	Chem 434 (Chem/Mat)
Math 243 (All)	Chem 343 (All)	Chem 445 (All)
MSS 200 (All)	Chem 344 (Chem/BioChem)	Chem 465 (Mat)
Physics 110 (All)	Chem 440 (Mat)	Chem 481 (BioChem)
Physics 215 (All)	Chem Conc 1 (Chem)	Chem 482 (BioChem)
Pol Sci 211 (All)	ECE 315 (All)	Chem 491 (BioChem)
S/T E/S Opt Chem 235 (All)	Engr Mech 340 (Mat)	Chem Conc 2 (Chem)
	History 302 (All)	Chem Conc 3 (Chem)
	Math 300/356 (All)	Chem Conc 4 (Chem)
	Philos 310 (All)	Chem Concentration (Mat)
		English 411 (All)
		Engr Mech 440 (Mat)
		Mgt 400 (All)
		MSS 400 (All)
		Soc Sci 412 (All)

CHEMISTRY (Chem)
Offered by the Department of Chemistry (DFC).

Chem 100. Applications of Chemistry I. Fundamental chemistry with emphasis on concepts underlying Air Force and other practical applications. Provides a foundation in inquiry-based learning to facilitate the development of critical thinking skills, data driven decision-making and technical writing skills. Topics include atomic and molecular structure, electronic structure, oxidation-reduction reactions, stoichiometry, chemical bonding and structure, chemical analysis, environmental chemistry and special topics. Laboratories emphasize both quantitative and qualitative analysis with computer interface for data collection and analysis. Highly recommended that technical majors take Chem 100 in their fourth-class fall. It must be taken in the fourth-class fall by those interested in medical career field or science majors – including chemistry, biochemistry, material chemistry and biology – as it allows proper sequencing for Chem 110 in the fourth-class spring semester.

Chem 110. Applications of Chemistry II. Applies the principles of chemistry in the development of analysis, synthesis and evaluation skills. Integrates chemical principles to develop comprehension of capabilities and limitations of air power in the 21st century. May include topics like gas laws, thermodynamics, acids and bases, electrochemistry, kinetics, chemical equilibrium, biochemistry and special topics. Teaches chemical principles within the framework of Air Force and other practical applications. Labs emphasize both quantitative and qualitative analyses with computer interface for data collection and analysis. Core substitute for Chem 200 course for fourth-class cadets considering the chemistry, biochemistry, materials chemistry or biology majors or interested in any pre-med program. Must be taken during the fourth-class year for major, accreditation and medical school application timelines.

Chem 200. Applications of Chemistry II. Continuation of Chem 100. Applies principles of chemistry in the development of analysis, synthesis and evaluation skills to develop comprehension of the capabilities and limitations of air power in the 21st century. Topics may include gas laws, thermodynamics, acids and bases, electrochemistry, kinetics, chemical equilibrium, biochemistry and special topics. Teaches chemical principles within the framework of Air Force and other practical applications. Labs emphasize both quantitative and qualitative analysis with computer interface for data collection and analysis.

Chem 222. Analytical Chemistry. Lecture and laboratory experience in quantitative analysis using both classical wet techniques and modern instrumentation. Topics may include proper use of laboratory equipment, preparing solutions, calculating experimental error, calibration methods, chemical equilibrium, titrations, spectroscopy, chromatography, mass spectrometry and electrochemistry. This course emphasizes using the analytical process to solve real-world problems, making accurate and precise measurements, analyzing and interpreting data, and using and understanding modern instruments.

Chem 230. Introductory Organic Chemistry. Introduces fundamentals of organic chemistry. Topics include: nomenclature of organic compounds; stereochemistry; reaction mechanisms; structure and function of organic functional groups; introduction to carbohydrates, lipids, amino acids and proteins, and nucleic acids; basic aspects of polymer chemistry. This is a service course primarily designed for biology and basic sciences majors. Chemistry majors and those students desiring to apply for medical school will not take this course in lieu of Chem 333 and 334.

Chem 235. Physical Chemistry I. Integrated lecture/laboratory course explores the fundamentals of chemical thermodynamics and equilibria involving gases, liquids and solutions, the analysis of phase equilibria, electrochemistry and chemical kinetics.

Chem 236. Physical Chemistry II. Integrated lecture/laboratory continuation of Chem 235; includes the fundamentals of quantum chemistry, including computational applications, spectroscopy, statistical mechanics, properties of solids and liquids, transport properties and surface chemistry.

Chem 325. Space Chemistry. Examines the integral role chemistry plays in our efforts to effectively utilize space. Topics may include the chemical derivation of the elements found in the universe, materials science, propulsion chemistry, how the Air Force exploits the space environment to accomplish the mission, and other subjects of current interest.

Chem 333. Organic Chemistry I. Scientific study of the structure, properties, composition, reactions and preparation of organic compounds. Topics include classification and naming of organic compounds, stereochemistry and conformational analysis, reaction and synthesis of alcohols, alkyl halides, alkenes and alkynes; conjugated systems; spectroscopy and structure determination. Concurrent enrollment in Chem 343 is recommended but is optional for non-chemistry majors.

Chem 334. Organic Chemistry II. Continuation of Chem 333. Topics include mechanisms and reactions of aromatic compounds, organometallics, alcohols, ethers and carbonyl-containing functional groups to include enolate chemistry. Emphasizes multi-step syntheses integrating the knowledge of multiple functional groups. Other topics such as carbohydrates, polynuclear aromatics, heterocyclic compounds, amino acids and proteins may be introduced.

Chem 343. Organic Chemistry Laboratory. Experiments in the preparation, purification and identification of representative organic compounds. Designed to illustrate the principles discussed in Chem 333 and develop techniques needed for the isolation, purification and characterization of organic materials. Sample preparation techniques include recrystallization, distillation, melting point determination, including sample preparation of IR, NMR, GC and GC/MS, as well as instrument operation and data interpretation.

Chem 344. Instrumental Organic Chemistry. Continuation of Chem 343. Techniques studied include applications of infrared, proton magnetic resonance, mass spectra and chromatographic analysis of organic materials synthesized in the laboratory. The principles of organic chemistry are tied together at the end of the semester in a special project designed to familiarize the student with library research, independent lab work, and illustrate the chemical principles studied in Chem 333 and Chem 334.

Chem 350. Chemistry of Weapons. Primary focus is on the chemistry associated with weapons, from construction to delivery to by-products and detection as a result of delivery or destruction. Topics covered include conventional explosives, propellants, chemical weapons, biochemical effects, munitions design and current topics. Emphasizes understanding the chemical principles and thermodynamic processes involved in a variety of current and future weapon systems.

Chem 353. Theory of Instrumental Methods of Chemical Analysis. Basic theory and real-world examples of modern analytical methods of chemical analysis. Topics include ultraviolet, visible, infrared absorption, Raman and emission spectroscopies; mass spectrometry, nuclear magnetic resonance and electron paramagnetic resonance spectroscopy; chromatography; thermal methods and other methods as appropriate. Applied numeric methods will also be discussed, with an emphasis on error analysis and determination of signal-to-noise ratio. Focuses on theory of methods currently applied in advanced courses offered in the Academy's Department of Chemistry.

Chem 381. Chemistry of the Environment. Discussion of the chemistry and alteration of the environment due to human impacts. Areas of study include atmospheric, soil, water and industrial chemistry; environmental contaminant properties; hazardous materials; waste disposal; toxicology; and environmental analytical techniques. Special topics of current or regional interest may be included. Emphasizes understanding the chemical principles, phenomena and basic chemistry associated with protecting and improving our environment.

Chem 399. Independent Study Techniques. Methods and strategies for proposing, planning and executing independent research. A useful lead-in to Chem 499. Knowledge and skills gained facilitate the initiation of research projects and improve efficiency of the research process. Exercises in searching the chemical literature, reading journal articles and preparation of proposals. With departmental permission, course may be combined with Chem 499B for three semester hours of independent study credit.

Chem 431. Theoretical Inorganic Chemistry. Theoretical approach to atomic structure, covalent bonding and molecular structures. Additional topics include a selection from the following options: acid-base chemistry; ionic compounds; a general survey of the periodic table, coordination chemistry, organometallics, catalysis, bio-inorganic chemistry and inorganic synthesis.

Chem 432. Systematic Inorganic Chemistry. Applications of Chem 431 with emphasis on a systematic study of the behavior of chemical elements and theoretical inorganic compounds. Lecture topics are selected from the chemistry of transition metals, organometallics, boron, bio-inorganic, fluxional molecules, kinetics and mechanisms of inorganic reactions and special topics. Laboratories provide hands-on experience in inorganic fundamentals and the reaction and characterization of metallic compounds.

Chem 433. Advanced Organic Chemistry. Advanced studies of chemical bonding and molecular structure; molecular orbital theory, aromaticity, structure-reactivity relationships, kinetics, mechanisms and linear free energy relationships. Topics include concerted reactions; conservation of orbital symmetry, frontier molecular orbitals, photochemistry, selected synthetic methods; nucleophilic carbon species, carbonyl compounds, principles of stereochemistry; asymmetric synthesis.

Chem 434. Biochemistry. Chemistry of the life processes. Topics covered include the chemistry of biomolecules (carbohydrates, lipids, proteins and nucleotides); energetics and metabolic control; enzymes; mechanisms and kinetics; intermediary metabolism, biosynthesis and function of macromolecules including DNA, RNA and proteins; introduction to biotechnology and recombinant DNA techniques.

Chem 435. Advanced Physical Chemistry. Development of molecular quantum mechanics and its application to molecular spectroscopy and chemical reaction dynamics. Topics include rotational, vibrational and electronic spectroscopy; chemical reaction dynamics with emphasis on theoretical calculations for reactions and advanced theoretical chemical methods. Laboratories provide hands-on experience in advanced physical chemistry concepts and characterization of the physical world.

Chem 440. Polymer Chemistry. Introduction to polymer chemistry. Lecture topics include discussions on the interrelations between molecular and gross physical properties, polymer structure, methods of polymerization, polymer development, and Air Force applications for polymers. Laboratories provide hands-on experience in synthesis of polymeric materials.

Chem 445. Advanced Laboratory Techniques. Designed to enhance students' experience in advanced laboratory techniques in inorganic, organic, analytical and physical chemistry. Experiments include preparation, purification, identification and analysis of representative organometallic and inorganic compounds.

Chem 453. Instrumental Methods of Chemical Analysis. Advanced theory and application of modern analytical instruments for chemical analysis. Experiments include ultraviolet, visible, infrared absorption and emission spectroscopies; nuclear magnetic resonance and electron paramagnetic resonance spectroscopy; chromatography; thermal methods; and electrochemical techniques. Emphasizes hands-on experience with modern instrumentation, applications to real-world and Air Force problems, computational data analysis and modeling.

Chem 465. Chemistry of Advanced Materials. Chemical studies in modern and high-tech materials emphasizing physical chemistry fundamentals, the interface between molecules and materials, and the development of these materials. Topics include chemical computational models, materials for energy storage, electronics, structures, optics and glasses. Laboratories provide hands-on experience in synthesis and characterization of materials.

Chem 481. Biochemistry I. Chemistry of living organisms emphasizing the roles played by biomacromolecules and macromolecular assemblies. Topics covered include an introduction to primary literature in biomedical research, cells and organelles, amino acids, nucleic acids, protein structures and enzymes, sugars and polysaccharides, lipids and membranes, and an introduction to metabolism.

Chem 482. Biochemistry II. Chemistry of living organisms emphasizing the central metabolic processes and the transmission of genetic information. Topics covered include glycolysis and other pathways of carbohydrate metabolism, the citric acid cycle, lipid and amino acid metabolism, signal transduction, DNA replication, transcription of DNA and RNA, and translation of mRNA into protein.

Chem 491. Biochemistry Laboratory. Experiments to manipulate DNA, RNA and proteins. Techniques covered include agarose and acrylamide gel electrophoresis, recombinant DNA techniques, microbial culture and transformation, cell culture, and production and purification of recombinant proteins. Lab is designed to illustrate the conceptual principles presented in Chem 481.

Chem 492. Advanced Biochemistry Laboratory. Continuation of Chem 491 which supplements material covered in Chem 482. Emphasizes advanced laboratory techniques in biochemistry. Includes the use of advanced chemical instrumentation (including selections from the following: infrared spectroscopy, UV/vis spectroscopy, NMR and EPR spectrometry, differential scanning calorimetry, fluorescence spectroscopy) to problems in the life science arena. Techniques learned in Chem 482 will be applied to current problems in the biochemistry literature.

Chem 495. Special Topics. Selected topics in chemistry.

Chem 499. Independent Study. Capstone course for all chemistry majors. A hands-on laboratory experience applying the culminated knowledge and skills gained in the major towards a novel research project. Individual research using state-of-the-art equipment under the direction of a faculty member. Includes use of chemical literature.

civil engineering major

Civil engineering is one of the broadest of the engineering disciplines, encompassing many interdependent technical specialties. As a civil engineer, students plan, design and supervise the construction of a wide variety of facilities, such as space stations and launching facilities, offshore structures, bridges, buildings, tunnels, highways, transit systems, dams, airports, irrigation projects, distribution facilities for water, and collection and treatment facilities for wastewater and hazardous wastes.

Students use technology's newest applications. Civil engineers are leading users of state-of-the-art computer methods in design, construction, project scheduling and cost control. Civil engineers are problem solvers, meeting the challenges of pollution, a deteriorating infrastructure, traffic congestion, energy needs, floods, earthquakes, urban development and community planning. As they develop skills, they can move into engineering management, oversee the completion of entire projects, and work closely with architects, owners, contractors, government officials and others involved in all aspects of construction.

Like the civil engineering profession, the Air Force civil engineering career field is also broad, including architects, electrical engineers and mechanical engineers, as well as civil engineers. Typically, an Air Force civil engineering officer can expect to work at both base and command level jobs. The civil engineer at base level is responsible for the construction and maintenance of all facilities; mechanical, electrical and waste disposal systems; hazardous waste management, runways and roads. Accordingly, Air Force civil engineering requires many specialties. Tasks may include technical design, project planning and programming, and possibly managing the maintenance work force of civilian and military personnel. At the command level, expertise is required to plan, manage and direct the civil engineering efforts on a command-wide basis.

For students who like science and mathematics and are curious about how things work, then perhaps civil engineering is the right major. The civil engineering major is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore MD 21202-4012 – telephone: (410) 347-7700. Upon graduation you earn a Bachelor of Science in civil engineering, a BSCE. A graduate with a civil engineering degree is eligible for a civil engineer, general engineer, bioenvironmental engineer, developmental engineer or flying Air Force Specialty Code.

The goal of the civil engineering program is to prepare cadets to become leaders of character who:

- Possess breadth of integrated, fundamental knowledge in the basic sciences, engineering, the humanities and social sciences; and depth of knowledge in civil engineering and broad knowledge in environmental engineering.
- Can communicate effectively.
- Demonstrate leadership and can work effectively with others.
- Are independent, lifelong learners.
- Can apply their knowledge and skills to frame and solve Air Force civil and environmental engineering problems.
- Understand their ethical and professional responsibilities as embodied in the Air Force Core Values.
- Can function effectively in contingency operations.

Upon successful completion of the Academy's Civil Engineering program cadets will successfully demonstrate:

- Application of the fundamental concepts of civil engineering to solve engineering problems.
- Laboratory techniques including design of experiments, procedures, recording and analysis.
- Engineering skills, including construction processes.
- Use of contemporary civil engineering analysis, design and test tools.
- Written and oral communication skills.
- Knowledge of ethical and professional responsibilities.
- Depth of knowledge and skills in civil engineering and breadth of knowledge and skills in environmental engineering, computers, mathematics and other disciplines to effectively identify and solve the types of complex, multidisciplinary problems they will face as Air Force environmental and civil engineers.
- Knowledge of the benefits and the skills needed to engage in life-long learning.
- Ability to be effective multidisciplinary team members.
- Skills to be independent learners while knowing when to seek help.
- Knowledge of the role of Air Force engineering officers in our global society.
- Knowledge of contemporary social, economic, political, military and engineering issues.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt/Design Opt
Civ Engr 330	Beh Sci 310	Astro Engr 410
Civ Engr 362	Biology 315	Bas Sci Opt
Econ 201	Civ Engr 361	Civ Engr 474
English 211	Civ Engr 372	Civ Engr 480
Engr Mech 220	Civ Engr 373	Civ Engr 488
Law 220	Civ Engr 390	Design Opt
Math 243	ECE 231	English 411
Math 245	Engineering Opt	MSS 400
MSS 200	History 302	Philos 310
Physics 215	Math 356	Soc Sci 412
Pol Sci 211	Sys Opt Engr 311	

CIVIL ENGINEERING (Civ Engr)
Offered by the Department of Civil and Environmental Engineering (DFCE).

Civ Engr 215. Computer Applications for Civil Engineers. Application of commercially available computer-based tools for solving common types of civil engineering problems. Mechanical drawing, using state-of-the-art computer-aided design (CAD) software, including presentation and working drawings. Use of spreadsheet and relational database software for the solution of simultaneous equations and linear programming with an emphasis on information input, data handling and professional output. Project management concepts and project planning using MS Project software. Introduction to GeoBase and geospatial mapping capabilities using GIS technologies.

Civ Engr 330. Elementary Structural Analysis. Static analysis of determinate structures. Stresses and deformations in beams, trusses and frames.

Civ Engr 351. Civil Engineering Practices - Field Engineering. This two-phase course includes Operation Civil Engineering Air Force (OpsCEAF) and a three-week field experience at the Academy Field Engineering and Readiness Laboratory (FERL). Second-class cadets spend first period at a government facility working on a project in the civil engineering field. Participants will be scheduled for a second or third summer period leadership program. The three-week field experience introduces surveying, construction materials, design of concrete mixes and hands-on construction using metal, timber, asphalt and concrete, and working knowledge of environmental systems. Students construct various projects that they will design in later civil and environmental engineering courses. OpsCEAF is in lieu of Operation Air Force (Mil Tng 301). OpsCEAF credit is Pass/Fail. Civ Engr 351 is graded.

Civ Engr 352. Lightweight Concrete Design, Analysis and Construction. The design and construction of the concrete canoe is an integration of several course experiences and develops students' understanding of fundamental concepts in concrete, structural design, hydraulics and computer applications. Students learn skills in project management, design, concrete technology, material testing and physical construction. Students use computer tools such as computer aided design to complete three-dimensional modeling, project management software to develop and track the progress of the project, spreadsheets to design concrete mix, and structural analysis packages to determine forces within the structure. Extensive time is spent in the laboratory testing the engineering properties of the concrete mixes and composite materials.

Civ Engr 355. Blast Effects and Protective Structures. Educates students on a broad range of technical issues dealing with mitigating the severe loading effects associated with abnormal loading incidents (e.g., blast, shock, impact, etc.). Introduces students to the effects of conventional and nuclear weapons on structures; enables students to define the threat of the hazard, define the loads on the structure, make a structural assessment of potential cause-and-effect relationships and recommend mitigation measures for designing or modifying the structural system to protect the people inside from the effects of explosive devices. Presents the latest information on designing buildings to save lives–from understanding the nature of threats to analysis and design–and provides students with practical information on performance and design requirements for hardened facilities. Provides information on blast damage assessment issues that will provide forensic and rescue personnel with information vital to rescue and investigative efforts after a catastrophic structure failure.

Civ Engr 361. Fundamental Hydraulics. Application of the principles of incompressible fluid mechanics. Topics include: fluid properties, manometry, forces on submerged bodies, open channel flow and conduit flow. Impulse-momentum, energy methods, Hardy-Cross method for balancing flows in distribution systems and sewer design are also covered.

Civ Engr 362. Introduction to Environmental Engineering. Fundamental theory and principles and preliminary design of unit operations in environmental engineering. Topics include air and water pollution, municipal and hazardous waste treatment, water chemistry, microbiology, mass balance, reactor theory and kinetics, and physical process theory.

Civ Engr 368. Ground and Surface Water Hydrology and Contaminant Transport. A comprehensive introduction to groundwater and surface water hydrology. Contaminant transport of hazardous chemicals in groundwater is also covered. Topics include: hazardous chemicals, environmental regulations, groundwater flow, well hydraulics, transport of contaminants in the subsurface environment, hydrologic cycle, surface water hydrology, hydrographs, rational method for storm water runoff and storm water collection system design.

Civ Engr 369. Introduction to Air Pollution. An in-depth introduction into air pollution covering such topics as the causes, sources and effects of air pollution. Topics include: legislative standards (ambient and source) for pollutants, regional and global air pollution issues, environmental health, indoor air pollution, noise, air pollution instrumentation and gas flow measurements, basic meteorology and dispersion modeling. The course work involves several laboratory exercises.

Civ Engr 372. Behavior and Analysis of Structures. Behavior and analysis of statically determinate and indeterminate beams, frames and trusses. Displacement calculations using virtual work. Analysis of indeterminate structures by consistent displacements and moment distribution. Introduction to general stiffness method. Computer analysis projects.

Civ Engr 373. Behavior and Design of Steel Members. Behavior of structural steel beams, columns, connections and frames; using the Load and Resistance Factor Design method. Design for tension, flexure, shear, compression and combined loads. Design of bolted and welded steel connections. Design project.

Civ Engr 390. Introduction to Soil Mechanics. Engineering properties of soils, soil classification, permeability, consolidation, compaction, shear strength and applications to engineering design. Soils laboratories and reports.

Civ Engr 405. Civil Engineering Seminar. A course designed to give civil engineering majors the opportunity to synthesize and apply the concepts they have learned throughout their undergraduate education. Topics discussed include engineering ethics and those that students may encounter in the Air Force after graduation.

Civ Engr 463. Wastewater Treatment Plant Design. Design of facilities for physical, chemical and biological treatment of wastewater; and treatment and disposal of sludge. Coverage of advanced wastewater treatment and land treatment systems. Laboratory exercises analyze raw sewage with data being used for the design processes. Final design project consists of a complete municipal wastewater treatment plant design.

Civ Engr 464. Architectural Design. Design of a single-family residence. Uses computer-aided-design and drafting (CADD) software in developing design: site plan, functional layout, framing, energy and electrical planning, aesthetic design, landscaping and mechanical planning. Produces set of design working drawings by end of course.

Civ Engr 467. Water Treatment Principles and Design. Design of unit operations for coagulation, sedimentation, filtration and disinfection for treatment of drinking water. Introduces the chemistry of drinking water treatment processes. Uses unit operations to design treatment solutions to contemporary environmental problems. Topics include design of ion exchange, reverse osmosis, chemical precipitation and selected hazardous waste disposal problems. Includes two complete design exercises.

Civ Engr 468. Solid and Hazardous Waste Facilities Design. Design and analysis of solid and hazardous waste management systems including collection, transport, processing, resource recovery and disposal. Hazardous waste regulations, treatment and site cleanup are addressed. Final design project consists of a complete landfill design.

Civ Engr 469. Design of Air Pollution Controls. Modeling and predicting the effects of air pollution, and the design of the facilities for air pollution control. The design of electrostatic precipitators, cyclones, bag houses and other methods for the control of air contaminants are addressed. Final design project.

Civ Engr 473. Structural Design. Design of a multi-story steel and reinforced concrete building, including structural frame, floor and roof system, and foundation. Computer-aided analysis and design.

Civ Engr 474. Behavior and Design of Concrete Members. Properties of reinforced concrete. Behavior and ultimate strength design of reinforced concrete beams, slabs, columns and footings. Design for flexure, shear, compression, bond and anchorage. Design project.

Civ Engr 480. Project Management and Contract Administration. Final course in the civil and environmental engineering capstone sequence. First-class students integrate discipline-specific design work from previous courses through a semester project. Students take an owner's project requirements through stages of scope definition, budgeting and planning, conceptual design, scheduling and construction contract administration. Students apply engineering standards and consider realistic issues including engineering economics, constructability, environmental requirements, sustainability and safety. The course addresses and applies management topics and concepts of planning, organizing, leading and controlling in the context of a capstone engineering project. Course concludes with a project competition involving construction industry professionals. Serves as a core replacement for Mgt 400 for civil engineering and environmental engineering majors.

Civ Engr 484. Applied Construction Principles. Students in this course will learn about design and construction processes, including the design-build approach to delivering building construction projects. They will study the roles of design-build team members, the steps in the process, and its legal aspects. They will prepare to participate in one or more categories of the Associated Schools of Construction annual regional student competition. Students will play the role of a firm competing to win a project award. Student products will include items such as a qualifications package, site plans, conceptual architectural designs, cost estimates, project schedules and construction plans. Students will also present their plans to a panel of industry representatives. At the completion of the competition, students work on another project for the remainder of the semester. Students will be key leaders in the "DFCE Apprentice" event in our Civ Engr 480 capstone course. Final project and final presentation.

Civ Engr 485. Construction Project Management. Emphasizes the methods and materials of construction as well as the management practices required to run a successful construction project. Topics include construction materials, project planning, scheduling, cost estimating and field engineering. A semester project, in the form of a detailed study of a major construction project, complements the classroom experience.

Civ Engr 488. Pavement Design and Transportation. Fundamental theory and design principles of both flexible and rigid pavements. Theory and practice in transportation systems to include airfield and highway design, traffic analyses, horizontal and vertical roadway alignment, pavement evaluation and maintenance, strengthening techniques and repair.

Civ Engr 491. Foundation Engineering. Design safe and reliable foundations using principles of classical soil mechanics. Design appropriate geotechnical site investigations to produce the required soil properties for geotechnical foundation design.

Civ Engr 492. Earth Structures: Embankments, Slopes and Buried Structures. Analyses of lateral earth pressures, slope stability and stresses on buried structures. Design of cantilever retaining walls, mechanically stabilized earth walls, sheet piling and slurry walls.

Civ Engr 495. Special Topics. Selected topics in civil engineering.

Civ Engr 499. Independent Study. Individual study and research in an advanced civil engineering topic approved by the department head.

computer engineering major

Computer systems are an integral part of every aspect of Air Force operations. These systems range from embedded devices that perform a specific function in a weapon system to massively-parallel supercomputers used to simulate an air campaign. Because today's computing systems are so sophisticated, a new field of engineering, computer engineering, has evolved. Computer engineers take a true "systems" view toward computing design, combining the algorithm-design skills of a computer scientist with the hardware-design talents of an electrical engineer. Computer engineering majors at the Academy acquire these skills through an interdisciplinary approach that intermingles courses from computer science with offerings from electrical and computer engineering. This course mix provides the broad, varied background an engineer needs to succeed in this dynamic field.

Students who successfully complete the computer engineering major are awarded a Bachelor of Science in computer engineering that is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 - telephone: (410) 347-7700. Computer engineering is an excellent choice if you are interested in an advanced degree. As a computer engineer, your knowledge and skill will be in high demand in the Air Force and in society as a whole.

The goal of the computer engineering program is to graduate leaders of character who:

- Possess breadth of integrated, fundamental knowledge in the basic sciences, engineering, the humanities and social sciences; and depth of knowledge in computer engineering.
- Can communicate effectively.
- Can work effectively with others.
- Are independent thinkers and learners.
- Can apply their knowledge and skills to solve Air Force engineering problems, both well- and ill-defined.
- Know and practice their ethical and professional responsibilities as embodied in the Air Force Core Values.

Upon completion of the computer engineering program each graduate shall demonstrate satisfactory:

- Application of the fundamental concepts of computer engineering to solve engineering problems.
- Laboratory techniques including procedures, recording and analysis.
- Design, fabrication and test techniques.
- Use of contemporary computer engineering analysis, design and test tools.
- Written and oral communication skills.
- Knowledge of ethical and professional responsibilities.
- Breadth and depth of knowledge and skills in computer engineering, computer science, electrical engineering, mathematics and other disciplines necessary to effectively identify and solve the types of complex, multidisciplinary problems they will face as Air Force engineers.
- Knowledge of the benefits and skills needed to engage in life-long learning.
- Ability to be effective multidisciplinary team members.
- Skills to be independent learners while knowing when to seek assistance.
- Knowledge of the role of Air Force engineering officers in our global society.
- Knowledge of contemporary social, political, military and engineering issues.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt/Comp Engr Opt
Comp Sci 210	Beh Sci 310	Astro Engr 410
Comp Sci 220	Biology 315	Comp Sci 467
Econ 201	ECE 321	Comp Sci 483
ECE 231	ECE 373	ECE 463
ECE 281	ECE 382	ECE 464
ECE 332	ECE 383	ECE 485
Engr Mech 220	English 211	English 411
Math 245	Law 220	History 302
MSS 200	Math 340	MSS 400
Physics 215	Math 356	Philos 310
Pol Sci 211	Sys Opt Engr 311	Soc Sci 412

ELECTRICAL AND COMPUTER ENGINEERING (ECE)
Offered by the Department of Electrical and Computer Engineering (DFEC).

ECE 373. Digital VLSI Circuits. Continuation of the study of electronics for computer engineering majors. Applies diode and field effect transistor concepts to the design and implementation of Very Large Scale Integrated (VLSI) circuits. Applies VHDL descriptions in concert with logic synthesis tools to generate mask level implementations of physical VLSI circuit design.

ECE 463. Capstone Design Project I. First course in the two-semester capstone design sequence for computer engineering majors. Presents contemporary methods essential to design, planning and execution of complex electrical and computer engineering projects. Includes instruction in contemporary Air Force project management methods and tools, organization of requirements, software and hardware specification and design, hardware fabrication, quality assurance and testing. Planning and prototyping the semester-long design project is completed in this course.

ECE 464. Capstone Design Project II. Second course in the two-semester project design sequence for electrical and computer engineering majors. Continues study of the system software and hardware lifecycle. Emphasizes system design, appropriate implementation in hardware and software, analysis, testing and evaluation, quality assurance and documentation. Uses a design project to emphasize Air Force applications.

All other ECE courses are listed under the electrical engineering major course description listing.

computer science major

Successful completion of the computer science major leads to the degree of Bachelor of Science in computer science and prepares students to be leaders in an information-based and network-centric Air Force. The computer science program is accredited by the Computing Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 - telephone: (410) 347-7700.

The goal of the computer science program is to produce leaders of character who:

- Possess knowledge in engineering, basic sciences, humanities and social sciences with depth of knowledge in computer science.
- Communicate effectively.
- Work effectively with others and grow into team leaders.
- Are committed to life-long development.
- Apply their knowledge and skills to solve problems for the Air Force.
- Know and practice their ethical and professional responsibilities as embodied in the Air Force Core Values.

Upon completion of the computer science program each graduate shall demonstrate satisfactory:

- Ability to apply knowledge of computing and mathematics appropriate to the discipline.
- Ability to analyze a problem and identify and define the computing requirements appropriate to its solution.
- Ability to design, implement and evaluate a computer-based system, process, component or program to meet desired needs.
- Ability to function effectively on teams to accomplish a common goal.
- Understanding of professional, ethical, legal, security and social issues and responsibilities in computing and the Air Force.
- Ability to communicate effectively with a range of audiences.
- Ability to analyze the local and global impact of computing on individuals, organizations and society.
- Recognition of the need for and an ability to engage in continuing professional development, both in computing and the Air Force.
- Ability to use current techniques, skills and tools necessary for computing practice.
- Ability to apply mathematical foundations, algorithmic principles and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
- Ability to apply design and development principles in the construction of software systems of varying complexity.

The computer science major offers both great challenges and great rewards. Most courses in the major involve computer programming, so successful majors enjoy programming and working with computers. Strong quantitative and analytical skills as well as determination and creativity are very useful for success in the major. Prior programming experience is not required for success in the major.

Most graduating computer science majors either enter a rated career field or the communications and information career field. Computer science majors successfully completing the cyber warfare option enter the Air Force as highly skilled information warriors.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt/Comp Sci Opt
Comp Sci 210	Beh Sci 310	Astro Engr 410
Comp Sci 220	Biology 315	Comp Sci 438
Comp Sci 351	Comp Sci 359	Comp Sci 426
Econ 201	Comp Sci 364	Comp Sci 454
English 211	Comp Sci 380	Comp Sci Opt
Engr Mech 220	Comp Sci 467	ECE 315
Law 220	Comp Sci 483	English 411
Math 340	History 302	Mgt 400
MSS 200	Math Opt	MSS 400
Physics 215	Math 356	Soc Sci 412
Pol Sci 211	Philos 310	Sys Opt Comp Sci 453

COMPUTER SCIENCE (Comp Sci)
Offered by the Department of Computer Science (DFCS).

Comp Sci 110. Introduction to Computing. Introduction to principles, applications, capabilities and limitations of computer systems. Topics include computer hardware, algorithms, information representation, networks, computer security, computers and society, system and application software, and computer programming. Students will learn how to use their own computers more effectively.

Comp Sci 210. Introduction to Programming. Introduces the fundamentals of software development as a foundation for a more advanced study of computer science. Topics include programming constructs, problem-solving strategies, algorithms, data structures, recursion and object-oriented concepts. Considerable attention is devoted to developing effective software engineering practices, emphasizing design, decomposition, encapsulation, procedural abstraction, testing, debugging and software reuse.

Comp Sci 211. Introduction to Programming for Scientists and Engineers. Introduces the fundamentals of software development as a foundation for solving scientific and engineering problems using computers. Topics include programming constructs, problem-solving strategies, algorithms and data structures. Considerable attention is devoted to developing effective software engineering practices, emphasizing design, decomposition, encapsulation, modularity, testing, debugging and software reuse. Students learn a programming language and development environment that is widely used within the engineering discipline.

Comp Sci 220. Data Abstraction. Continues the introduction of software development, with a particular focus on the ideas of data abstraction, object-oriented programming and fundamental data structures. Topics include recursion, computational complexity, event-driven programming, graphical user interface design and implementation, and fundamental computing algorithms.

Comp Sci 310. Information Technology. Provides the necessary computing skills for students to solve a wide variety of problems using a computer and application software. Topics include the World Wide Web, hardware and software selection, desktop publishing, spreadsheet analysis, information storage and retrieval, information visualization, computer security and telecommunications. Suitable for students in any academic major, including divisional majors.

Comp Sci 315. Web Design and Construction. Provides students experience in designing and building web-based applications. Topics include web page design, web development tools, browser capabilities, HTML, XML, client-side scripting, server-side scripting and web security issues.

Comp Sci 351. Computer Organization and Architecture. Expands on basic computer logic systems from prerequisite courses by introducing and contrasting major types of computing system organizations and introducing machine and assembly language programming. Topics include performance analysis, computer arithmetic, data path and control, pipelining, virtual memory, I/O, device drivers and parallel processing.

Comp Sci 359. Programming Paradigms. Applied course studying four different programming paradigms. Imperative, Object-Oriented, Functional and Logic programming paradigms are covered. Programming languages and specific language constructs supporting the four paradigms are covered, but the emphasis is on how to think about programming in each paradigm. At least one programming project is assigned for each of the four paradigms.

Comp Sci 362. Computer Simulation. Introduction to computer simulation and modeling of real-world systems. Topics include system analysis and modeling; principles of computer simulation methodologies; data collection and analysis; selecting distributions; simulation programs using general purpose languages; simulation using special simulation languages; analysis of results; and selecting alternative systems. The course includes the preparation of several computer programs using general and special purpose simulation languages and a group project involving the analysis of a real world system.

Comp Sci 364. Information Storage and Retrieval. Introduction to the basic concepts of database and information storage systems. Topics include data models, database design theory, database performance, transaction processing, web-database interaction, techniques for handling large volumes of data and contemporary database issues. Hands-on projects emphasize basic database and information storage and retrieval techniques.

Comp Sci 380. Design and Analysis of Algorithms. Advanced design and analysis of algorithms used in modern computing systems. Topics include analysis of algorithms, basic structures, advanced abstract data types, recursion, computability and complexity. Problem solving and analytical skills are improved by examining the application of abstract data types to several problem domains with an emphasis on the impact of design decisions on algorithm performance. Concepts are reinforced by several programming exercises.

Comp Sci 426. Languages and Machines. Students learn the theoretical foundations of computer science and apply these concepts to appropriate stages in compiler implementation. Topics include finite automata, formal language theory, grammars, scanners, parsing techniques, code generation, symbol tables and run-time storage allocation. Students design and implement a syntax-directed compiler for a high-order programming language.

Comp Sci 431. Cryptography. Introduces the principles of cryptography and number theory. Topics include: primes, random numbers, modular arithmetic and discrete logarithms, symmetric encryption, public key encryption, key management, hash functions, digital signatures, authentication protocols and protocols for secure electronic commerce. Elliptic curves and quantum cryptography will also be introduced.

Comp Sci 438. Computer Security and Information Warfare. Introduction to the technical aspects of information warfare. Emphasizes computer systems and networks are secured in order to protect them from an information warfare attack. Topics include viruses, worms, hacking, phreaking, authentication, access and flow controls, security models, encryption, intrusion detection and firewalls.

Comp Sci 453. Software Engineering I. First course of a two-semester capstone sequence for computer science majors. Students learn about issues related to developing large software systems. Topics include software development process lifecycles, software project management, configuration management, quality assurance management, requirements elicitation, system analysis, specification, software architecture, high-level design and testing. Students begin work on a two-semester software development project for a real customer.

Comp Sci 454. Software Engineering II. Second course of a two-semester capstone sequence for computer science majors. Students learn about issues related to developing large software systems. Topics include detailed design, implementation, maintenance and contemporary software engineering issues. Students complete work on a two-semester software development project for a real customer.

Comp Sci 467. Computer Networks. Examination of modern data communications systems and related security issues. Topics include the TCP/IP reference model, data transmission theory, network design issues, internetworking, routing, network protocols, implementation of networks, web application architecture, communications security and cryptography.

Comp Sci 468. Network Security. Focuses on the design and analysis of secure TCP/IP networks. Includes significant hands-on implementation of current network security models and theory in an advanced, multi-operating system lab. Topics include: secure network design principles, advanced TCP/IP security issues, packet filtering, stateful and proxy firewalls, network perimeters, threat and vulnerability assessment, host hardening honey nets, network intrusion detection and computer forensics. Course culminates in an exercise where students design, configure and secure a live network that is attacked by "Red Teams."

Comp Sci 471. Artificial Intelligence. Introduction to major subjects and research areas in artificial intelligence (AI). Topics include: problem solving techniques, knowledge representation, machine learning, heuristic programming, AI languages, expert systems, natural language understanding, computer vision, pattern recognition, robotics and societal impacts. Also explores current and projected uses of AI in the Air Force.

Comp Sci 474. Computer Graphics. Basic concepts of interactive computer graphics including both vector and raster graphics. Topics include mathematics of 2-dimensional and 3-dimensional geometric transformations, interactive techniques, graphics hardware architectures, graphic algorithms and realism in computer-generated images. Includes several computer projects.

Comp Sci 483. Operating Systems. Examines the design and implementation of programs that manage hardware resources and provide abstract interfaces for hardware control. Topics include resource allocation, synchronization primitives, virtual memory, information protection, performance measurement, I/O sub-subsystems and distributed computing.

Comp Sci 495. Special Topics. Selected topics in computer science.

Comp Sci 496. Computer Science Seminar. Advanced topics in computer science. Students participate in and lead discussions on significant issues in current computer science research as well as key historical developments.

Comp Sci 499. Independent Study. Individual study and research supervised by a faculty member. Topic established with the department head.

economics major

Economics is the scientific study of how individuals and institutions use their limited resources to satisfy their unlimited wants. The discipline begins with a sequence of core economic courses and then branches outward allowing students to focus on the international arena, public policy and finance, or quantitative economics. The major is designed to help students develop analytical skills which can be applied in a variety of circumstances. Students acquire the tools necessary to solve a wide range of problems such as allocating military personnel, analyzing a company's production efficiency, and evaluating the effect of government regulations. The economics major develops problem solving techniques which have been proven effective in today's changing Air Force environment and is widely recognized as a solid background for careers in business, government, law and teaching.

The goal of the economics program is to graduate leaders of character who:

- Apply the Economic Way of Thinking to analyze and solve problems.
- Evaluate incentive structures of institutions /organizations /markets using the concepts of: opportunity cost, marginal analysis, supply and demand, specialization, gains from trade and macroeconomics.
- Evaluate alternatives and the intended /unintended consequences of policy decisions to make optimal choices.
- Critically analyze economic, public issue, policy, national security or other (multi-disciplinary) problems.
- Understand the strengths and the limitations of economic analysis.
- Use positive /normative principles in relation to ethical implications.
- Choose appropriate analytical tools to solve economic problems.
- Effectively communicate economic concepts and analyses.
- Explain (verbally and written) analytical and statistical concepts to non-economists.
- Construct persuasive arguments, based on economic insights, regarding rational choices.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Biology 315	Aero Engr 315	Academy Opt
Chem 200	Beh Sci 310	Astro Engr 410
Econ 201	Econ 332	Econ 450
Econ 240	Econ 333	Econ 465
English 211	Econ 355	Econ 478
Engr Mech 220	Econ 356	Econ Elective
History 302	Econ 365	Econ Elective
Law 220	Econ Elective	Econ Elective
MSS 200	ECE 315	English 411
Physics 215	Math 356	Mgt 400
Pol Sci 211	Mgt 341	MSS 400
Sys Opt Ops Rsch 310	Philos 310	Soc Sci 412

ECONOMICS (Econ)
Offered by the Department of Economics and Geosciences (DFEG).

Econ 201. Introduction to Economics. Introduces the economic way of thinking so that graduates can understand the world around them in economic terms and apply economic concepts to the challenges they will face as Air Force officers. Focuses on using economic analysis to improve students' critical thinking, decision-making and quantitative literacy skills to make them more effective leaders. Graduates can apply these skills to analyze economic policy, defense economics, engineering economics and personal finance issues. Graduates also develop literacy in the national and international economic environment in order to understand contemporary issues and public policy.

Econ 240. Development of Economic Thought. Modern economic theory developed in response to a variety of economic forces beginning with the Industrial Revolution through the Great Depression and into today's globalization of the world's economy. Course links these forces with some of the great economic thinkers of the past such as Adam Smith, Karl Marx, Alfred Marshall and John Maynard Keynes. Upon completion of this course, students will have gained an appreciation of how today's economic theories have been influenced by the economic conditions that their originators experienced.

Econ 301. Macroeconomic Principles for the U.S. and the World. Foundations of key macroeconomic principles for non-econ majors. Examination of a nation's economy at the aggregate level. Analytical models are developed and applied to real-world events explaining the functioning of the macroeconomy. Focus is on developing tools that can be used to analyze the macroeconomic goals and performance of economies around the world. Topics include growth, national income, inflation and deflation, unemployment, fiscal policy, monetary policy, debt, deficits, currency, exchange rates, trade and international finance.

Econ 332. Microeconomic Theory I. First course in a calculus-based treatment of microeconomic theory. In-depth analysis of market supply and demand, utility theory, consumer optimization, demand functions, income/substitution effects and elasticity. Includes a treatment of choice under uncertainty, markets with asymmetric information, externalities, public goods and other related topics.

Econ 333. Microeconomic Theory II. Second course in a calculus-based treatment of microeconomic theory. In-depth analysis of production functions, long-run and short-run cost functions, and profit maximization. Also includes a study of market structures, game theory and other related topics.

Econ 351. Comparative Economic Systems. Examines the world's major economic systems including capitalism, market socialism and planned socialism. These systems are examined through a critical analysis of the theoretical literature and case studies. Areas of study include the United States, the European Union, China, the Middle East and parts of the developing world. Both economic and non-economic aspects of these countries' systems are examined to come to an understanding of how these countries work and why countries experience different results despite similarities in their systems.

Econ 355. Principles of Macroeconomics. Foundations of key macroeconomic principles. Analysis of the macroeconomics of a nation at an aggregate level. Analytical models are developed and used to analyze the impacts of alternative government economic policies. Topics include inflation, unemployment, national income, the banking system, fiscal and monetary policy, debt, deficits, and international finance and trade (including exchange rates and barriers to trade). Focuses on domestic and global economic environments of organizations and discusses current and historical issues in the macroeconomy relating to real-world events. Discusses the impact of macroeconomic policies on the defense sectors.

Econ 356. Macroeconomic Theory. Analysis of national income, employment, price level determination, growth, monetary and fiscal policies. Contemporary macroeconomic issues are explored using both closed and open economy scenarios. Modern business cycle theory and stabilization policy are examined from the vantage point of varying macroeconomic schools of thought.

Econ 365. Analysis of Economic Data. Survey of economic data series available from the Economic Report of the President, Commerce Department, Bureau of Labor Statistics, Federal Reserve and financial data. Develops familiarity with macro, micro and financial data series, what the series measure, accessing series via the Internet, and basic analysis to include the use of software.

Econ 374. Survey of International Economic Issues. Examination of current issues in the commercial relations among nations, including international trade, international finance, economic development and the multinational enterprise. Designed for those students not majoring in economics.

Econ 377. Financial Markets. Introduction to and analysis of how the financial markets allocate personal and corporate resources in a modern capitalistic economy. Specific emphasis on the characteristics, valuations and functions of the various financial instruments traded in the financial markets. Also covered in some depth are the operational mechanisms of the financial markets, the relationship of government fiscal and monetary policies to finance market activity, the individual and corporate investment decision, and the understanding of financial press information.

Econ 411. Introduction to Game Theory. Introduces the concepts required to analyze strategic situations or situations in which a player's payoff depends on his choices and those of the other players. Topics include zero-sum and nonzero-sum games, normal and extensive form games, the implications of informational asymmetries on these strategic situations, auctions, and bargaining models. Developing the ability to think strategically is valuable to everyone, but this course is especially important for those studying any of the social sciences.

Econ 422. Labor Economics. Examines how people make decisions regarding their participation in the labor market. Included is the examination of government policies (such as social security, minimum wage, etc.) and their impacts on the supply and demand of labor. Wage determination for women and minorities will be discussed in light of the supply and demand forces in the influence of the human capital decisions made by individuals.

Econ 447. Quantitative Economic Methods. Analysis of economic problems through statistical and mathematical methods and the use of quantitative models.

Econ 450. International Economics. Course covers several main concepts and methods of international economics, such as: the gains from and patterns of trade; motives, methods and consequences of protectionism; and international finance.

Econ 454. Economics of Transition and Development. Studies the transition of centrally planned or state-run economies to market based economies, as well as the problem of sustaining accelerated economic growth in less developed countries. Focuses on price liberalization, stabilization efforts and the economic restructuring necessary to move a centrally planned economy to a market based economy. Additionally, covers economic growth, population growth, income inequality, trade and investment. Case studies from Eastern Europe, Latin and South America, Asia and Africa may be included.

Econ 457. Economies of Asia. Analyzes the major issues defining Asian economies today. Major topics include internal and external balance, growth and development strategies, currency regimes, economic integration, trade and globalization, among others. The role of Asia in the world economy is analyzed. The "Asian Miracle" and the "Asian Crisis" are examined as they pertain to the current economic situation.

Econ 459. Economics of Latin America. A broad overview of the major economic issues affecting U.S. relations with Latin America, including trade liberalization, foreign investment, economic integration, external debt problems, environmental protection and the impact of drug production and trafficking. Provides an appreciation of the rising importance of Latin American countries as trading partners of the United States and analysis of the region's unique economic and social problems. Pays special attention to the prospects for further regional economic integration under NAFTA and other regional trade groups.

Econ 465. Introduction to Econometrics. Application of statistical tools to economic data, concentrating on methodology, econometric model building and statistical inference.

Econ 466. Forecasting and Model Building. Continues development of econometric techniques, with emphasis on time series forecasting procedures and on methods to make optimal use of sparse or deficient data in statistical model estimation. Recommended for those students planning to pursue graduate study.

Econ 473. Public Finance. Economics of the government sector, with emphasis on public goods, taxation, fiscal policy and government regulation.

Econ 475. Money, Banking and Financial Institutions. Advanced treatment of money and its role in the economy. Critical analysis of financial structure and institutions, the Federal Reserve System and the increasing importance of the global financial arena. Special emphasis on financial events and policy issues.

Econ 478. Seminar in Defense Economics. Applies macroeconomic and microeconomic theories to analyze a variety of defense policy issues. Examples of topics typically covered include: defense alliances, military personnel system and pay, the defense industrial base and acquisition.

Econ 495. Special Topics. Selected topics in economics of either an advanced treatment or general interest orientation.

Econ 499. Independent Study. Tutorial investigation of a specific area of economics.

electrical engineering major

The battlefield of the 21st century is increasingly an electronic one; electrical engineers (EEs) are leading the way in creating the technology that dominates. Without EEs, modern computers, control systems or even high-fidelity sound systems would not be possible. Indeed, the modern military would not have its current capabilities without electronics and electrical engineers. Electronic systems are everywhere: sophisticated sensors detect and locate targets, "smart" computer guided munitions attack targets with amazing accuracy, aircraft fly "by wire," advanced radios provide reliable communications in high jamming environments, and aircrews depend on terrain following radar. All these systems are critical to the success of today's Air Force; the Air Force's future depends heavily on continued progress in these areas. The electrical engineering major covers the basic principles behind these systems and provides graduates with valuable insight into their operation. Officers who understand the technology and can use it to their advantage will have the "combat edge" over the opponent. If you want to help the Air Force find new and better ways to accomplish its mission, this major may be for you.

Students successfully completing the electrical engineering major are awarded a Bachelor of Science in electrical engineering that is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 - telephone: (410) 347-7700. The electrical engineering major is an excellent choice if you are interested in an advanced degree. As an electrical engineer, your knowledge and skill will be in high demand both in the Air Force and in society as a whole.

The goal of the electrical engineering program is to graduate leaders of character who:

- Possess breadth of integrated, fundamental knowledge in the basic sciences, engineering, the humanities and social sciences; and depth of knowledge in electrical engineering.
- Can communicate effectively.
- Can work effectively with others.
- Are independent thinkers and learners.
- Can apply their knowledge and skills to solve Air Force engineering problems, both well- and ill-defined.
- Know and practice their ethical and professional responsibilities as embodied in the Air Force Core Values.

Upon completion of the electrical engineering program each graduate shall demonstrate satisfactory:

- Application of the fundamental concepts of electrical engineering to solve engineering problems.
- Laboratory techniques including procedures, recording and analysis.
- Design, fabrication and test techniques.
- Use of contemporary electrical engineering analysis, design and test tools.
- Written and oral communication skills.
- Knowledge of ethical and professional responsibilities.
- Breadth and depth of knowledge and skills in electrical engineering, computer science, mathematics and other disciplines necessary to effectively identify and solve the types of complex, multidisciplinary problems they will face as Air Force engineers.
- Knowledge of the benefits and the skills needed to engage in life-long learning.
- Ability to be effective multidisciplinary team members.
- Skills to be independent learners while knowing when to seek assistance.
- Knowledge of the role of Air Force engineering officers in our global society.
- Knowledge of contemporary social, political, military and engineering issues.

The Department of Electrical and Computer Engineering offers four different suggested areas of study: electronics, communications, computer systems and controls. There is also a universal area that allows you to take any two electrical engineering options.

Electronics–This area of study provides a general foundation in all areas of electrical engineering. The emphasis is on electronic design, components and applications. It is well suited to those who want to retain the flexibility to work and/or do graduate studies in electrical engineering, physics, medicine or other technical fields.

Communications–Classes in this area of study are the basis for understanding modern radar and communication systems. Topics include fiber optics, modulation techniques, radio components and antennas. Study in this area leads to a better understanding of satellite communications and systems, telephones, stealth technology and advanced radar systems.

Computer Systems–In this area of study, the fundamentals and advanced concepts of computer design are explored. Topics include microcomputers, system design and interfacing, and computer architecture. Classes in this area of study lead to a better understanding of modern computer systems and digital hardware design.

Controls–This area of study consists of two courses taught by the Department of Astronautics. The analysis and design of automatic control systems is emphasized. Control systems are integral components of modern society, from a simple thermostat to space vehicles.

Universal Area–You are free to choose two classes from the approved "elective options" list to fulfill the electrical engineering major's elective. These electives provide the opportunity to "pick and choose" classes that interest you.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt/ECE Opt
Econ 201	Beh Sci 310	Astro Engr 410
ECE 231	Biology 315	ECE 434
ECE 281	ECE 321	ECE 447
ECE 332	ECE 322	ECE 463
English 211	ECE 333	ECE 464
Engr Mech 220	ECE 343	ECE Opt
Math 243	ECE 382	English 411
Math 245	Law 220	History 302
MSS 200	Math 346	MSS 400
Physics 215	Math 356	Philos 310
Pol Sci 211	Sys Opt Engr 311	Soc Sci 412

ELECTRICAL ENGINEERING (ECE)
Offered by the Department of Electrical and Computer Engineering (DFEC).

ECE 231. Electrical Circuits and Systems I. Introduction to circuit analysis and system design. Topics include: circuit models and simulations of electrical devices and systems, nodal and mesh analysis, Thévenin and Norton equivalent circuits, dependent sources, operational amplifier circuits, transient and frequency response of first-order circuits, sinusoidal steady state response, and military and civilian applications.

ECE 281. Introductory Digital Systems. Introduction to the fundamental principles of logic design. Topics include: Boolean algebra, combinational and sequential logic networks with basic design and analysis techniques, very high speed design languages (VHDL), field programmable gate assemblies (FPGA), and an introduction to digital processing systems. Laboratory projects include the design of digital systems and the analysis of computer architecture.

ECE 315. Principles of Air Force Electronic Systems. Introduction to electrical and computer engineering principles applied to Air Force electronic systems through signal analysis and electronic system design and evaluation. Topics include signal representation, the realization of digital and analog systems using electronic functions, and their application to Air Force systems.

ECE 321. Electronics I. Introduction to semiconductor electronics. Covers qualitative and quantitative analysis of semiconductor devices with emphasis on the diode and field effect transistor. Includes modeling, analysis and design of related circuits, including combinational and sequential digital logic.

ECE 322. Electronics II. Continuation of ECE 321 for electrical engineering majors. Extends basic semiconductor concepts to the bipolar junction transistor. Extends modeling and circuit analysis processes to circuits containing multiple transistors including differential/operational/power amplifiers, frequency response, feedback and stability.

ECE 332. Electrical Circuits and Systems II. Continuation of circuit analysis and system design. Topics include transient response of second order circuits, mutual inductance, Laplace transform techniques in circuit analysis, analog filter design and two-port networks.

ECE 333. Continuous-Time Signals and Linear Systems. Introduction to analog signal processing by linear, time invariant systems. Topics include signal characterization, convolution, Fourier analysis methods and state variable techniques.

ECE 343. Electromagnetics. Study of Maxwell's Equations, plane waves, transmission and radiating systems. Topics include wave propagation, transmission lines, waveguides and antennas.

ECE 360. Instrumentation Systems. Principles and design of modern data acquisition and instrumentation systems for non-electrical engineering majors. Includes measurement techniques, transducers, analog and digital data processing systems and displays.

ECE 373. Digital VLSI Circuits. Continuation of the study of electronics for computer engineering majors. Applies diode and field effect transistor concepts to the design and implementation of very large scale Integrated (VLSI) circuits. Applies very high speed design languages (VHDL), descriptions in concert with logic synthesis tools to generate mask level implementations of physical VLSI circuit design.

ECE 382. Microcomputer Programming. Provides a broad base understanding of microcontroller systems. The microcontroller principles presented provide a foundation that can be used in other courses to simplify projects (in some cases, substantially). Includes design, application, interfacing, assembly language and microcontroller hardware. Lab projects emphasize applications and interfacing.

ECE 383. Microcomputer System Design I. Course in the design of digital systems using microprocessors. Topics include structured system design, microprocessor instruction sets, support software and system timing. Also covered are input/output, peripherals and hardware-software interfacing techniques.

ECE 387. Introduction to Robotic Systems. Provides fundamental knowledge on robotic systems. Topics include kinematics, dynamics, motion control, controller design and trajectory planning of robot manipulators. Introduces basic computer vision techniques.

ECE Discrete-Time Signals and Systems. Introduction to digital signal processing. Topics include classical solutions to linear difference equations, the z-transform, digital filter design, quantization effects of analog-to-digital and digital-to-analog converters, frequency analysis of decimation and interpolation, discrete Fourier transform, and the fast Fourier transform.

ECE 444. Applied Field Theory. Topics include antennas, fiber optics, scattering, Fourier optics, radio wave propagation, radar cross-section and numerical methods. Analysis and design of practical systems are emphasized. A few lessons are reserved for current state-of-the-art topics, such as stealth technology, adaptive antennas and holography.

ECE 446. Applied Communication Systems. Introduction to modern electronic communications systems with application in satellite communications. Analyzes the performance of various analog and digital modulation and detection methods. Coverage includes theory of operations of various modulation systems, effects of random noise, bandwidth, propagation channels and other design constraints. ECE 446 is not appropriate for ECE majors.

ECE 447. Communications Systems. Introduction to modern electrical communications. Analyzes the performance of various modulation and detection methods for both analog and digital systems. Coverage includes theory of operation, effects of random noise, bandwidth and other communication design constraints.

ECE 448. Wireless Communications. Follow-on course to ECE 447 that applies the knowledge of random processes and spectral analysis to the performance of wireless communication corrupted by noise. Advanced topics that vary from semester to semester include satellite communications, image processing, data communications and fiber optics.

ECE 463. Capstone Design Project I. First course in the two-semester capstone design sequence for electrical engineering majors. Presents contemporary methods essential to design, planning and execution of complex electrical and computer engineering projects. Includes instruction in contemporary Air Force project management methods and tools, organization of requirements, software and hardware specification and design, hardware fabrication, quality assurance and testing. Planning and prototyping the semester-long design project is completed in this course.

ECE 464. Capstone Design Project II. Second course in the two-semester project design sequence for electrical and computer engineering majors. Continues study of the system software and hardware lifecycle. Emphasizes system design, appropriate implementation in hardware and software, analysis, testing and evaluation, quality assurance and documentation. Uses a design project to emphasize Air Force applications.

ECE 472. Instrumentation System Fundamentals. Introduction to instrumentation components. Analysis and design of advanced operational amplifier circuits, including Schmitt trigger, waveform generators, instrumentation amplifiers and active filters. Discussion and practical design of transducer circuits to instrument various processes.

ECE 473. Introduction to CMOS VLSI Circuit Design. Introduction to design of Very Large Scale Integrated (VLSI) circuits in silicon Complementary Metal Oxide Semiconductor (CMOS) technology. Includes discussions of CMOS fabrication technology, combinational and sequential logic structures, analog circuit structures, computer aided layout and simulation techniques, load/timing analysis and integrated systems design techniques/considerations.

ECE 484. Microcomputer System Design II. Culmination of the Computer Systems area of study design sequence using microprocessors. Students investigate advanced peripheral interfacing techniques, advanced memory systems, advanced bus features, coprocessors, serial communications, cross-compilers and digital-to-analog conversion. This is accomplished through a series of laboratory design exercises.

ECE 485. Computer Architecture. Final course in the Computer Systems area of study quantitatively examines tradeoffs in the design of high-performance computer systems. Topics include price/performance, instruction sets, hardwired control versus microprogramming, memory hierarchy, cache memory, virtual memory, pipelining, Reduced Instruction Set Computers (RISC), input/output and parallel processing. Final project examines state-of-the-art processors and computers.

ECE 495. Special Topics. Selected topics in electrical engineering. Typical subjects include audio power amplifier design, laser optics and weapons, advanced signal and image processing, and advanced electronic circuits.

ECE 499. Independent Study. Individual study and research in an engineering design topic approved by the department head.

english major

You study at the Air Force Academy to become a leader in our nation's military. Outstanding leadership starts with effective communication. That's exactly what you'll learn as an English major. Leaders throughout history have used their skills as readers, thinkers and communicators to change the world. This is the essence of the English major. You'll focus on literature, imagination and communication as deliberate human endeavors. You'll explore the most perplexing questions of the human condition: What does it mean to be human? What is the source of our greatness and our depravity, our nobility and our pathos? For what ideals and against what forces must we fight? How will you persuade others, especially those you lead? How will you help them understand? The ultimate goal of the warrior-scholar is wisdom–a vision that transcends the ephemeral and the superfluous. The study of literature and communication offers the wisdom of generations to a new generation of leaders: you.

The courses you study as an English major reflect a combination of the rigorous traditions of the discipline and your personal interests. The program is extremely flexible, allowing you to explore the literature and ideas that excite your curiosity. You'll be able to pattern a curriculum suited to your desires–one that's sure to enrich your intellectual life. For those students who show outstanding potential, research grants for work at civilian institutions are available, as well as opportunities to present papers at professional conferences and to have research published.

If you enjoy reading, thinking and communicating, the English major is for you. Your studies as an English major will give you practical training in leadership. Great literature provides examples of human value systems and human relations—occasions for you to experience and appreciate the art of dealing with people before you receive your commission in the Air Force.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt
Econ 201	Beh Sci 310	Astro Engr 410
English 341	Biology 315	English 353
English Opt 1	ECE 315	English 370
Engr Mech 220	English 390	English 470
For Lang 3	English 461	English 490
For Lang 4	English 462	English Opt 4
Law 220	English Opt 2	English Opt 5
MSS 200	English Opt 3	English Opt 6
Physics 215	History 302	Mgt 400
Pol Sci 211	Math 300	MSS 400
Sys Opt Geo 310	Philos 310	Soc Sci 412

ENGLISH (English)
Offered by the Department of English and Fine Arts (DFENG).

English 109. Academic Communication for English as a Second Language Students. Introduction to academic reading and writing for English as a Second Language (ESL) students. Frequent writing assignments emphasize writing for the various academic communities. Emphasis on the rhetorical, syntactical and grammatical conventions of written English.

English 111. Introductory Composition and Research. Teaches the fundamentals of sound writing and rhetorical practices. Introduces students to methods and resources for academic research. Provides instruction and practice in the presentation, integration and documentation of researched material. Establishes the foundation for analytical thinking through frequent reading and writing assignments.

English 211. Literature and Intermediate Composition. Refines the analytical and critical reading skills introduced in English 111 through the examination of significant literary texts. Course objectives include acquiring skills in analytical and argumentative writing, research methods and documentation, critical reading and effective oral communication. Written assignments and class exercises incorporate analysis and research and provide a foundation for communication skills advanced in English 411. Midterm explication paper and final research essay. All fourth-class cadets who have validated or received transfer credit for English 111 should enroll in English 211 at their earliest opportunity.

English 340. Technical Writing and Communication. Covers the principles of organizing, developing and writing technical information. Teaches the technical writing conventions such as headings, illustrations, style, rhetorical patterns and tone common to scientific and technical disciplines. Considers how cyberspace effects communication practices and how today's leaders use and present technical information to accomplish the mission. Builds skills in critical thinking, writing, research and document design.

English 341. Literary Criticism. Introduces the theory and practice of literary criticism. Concentrates on major critical approaches, applying them to representative literature and showing how they lead the reader to deeper understanding and satisfaction from the work of art.

English 353. Shakespeare. Intensive study of Shakespeare's poetry and major plays within the cultural and historical perspectives of Renaissance England. Students attend a stage production of one play when available. Designed for students in any major.

English 360. Classical Masterpieces. Studies influential genres of the classical tradition, including epic, drama and history. Authors have included Homer, Sophocles, Aristophanes, Thucydides, Virgil, Tacitus and Dante. Key concepts to be studied include the role of the hero, the nature of political institutions, and the relationship between humans and the divine—in short, the foundations in Greek, Roman and medieval European culture.

English 365. Television News: Production and Performance. Examines and uses the fundamentals of television production including: directing, writing and operating the various pieces of equipment necessary for producing television programs. Students produce, write, direct and perform in the weekly "Blue Tube" program broadcast via closed-circuit television to the Academy community. Lab work stresses understanding basic television production fundamentals, public speaking skills, and how to use electronic technology to communicate to a mass audience. Additionally, students hone critical analysis skills by completing a 4-6 page paper examining their motivation for entering the profession of arms.

English 370. Speech Communication: Theory and Practice. Considers selected topics in advanced speech communication through informative and persuasive speaking. Frequent speaking assignments.

English 375. Creative Writing. Examines techniques of creative writing. In a workshop atmosphere, students experiment with writing, focusing generally on a specific form such as the short story, personal essay or poetry. The student's own work becomes the focus of discussion and attention.

English 380. Topics in Race, Gender, Class and Culture. Topics in literature, communication theory, linguistics and rhetoric. The course explores issues relating to class, gender and culture, including international and interdisciplinary topics. Emphasis changes for each offering, but may focus on the literature of women, the rhetoric of class, the impact of culture on linguistics, minority writers in the Americas, or African-American influence on American culture. Seminar approach.

English 383. Literature and Science. Considers the interrelationships among science, technology and literature—nonspeculative and speculative, science fact and science fiction. Eclectic in topical coverage, the course examines both the impact of science on literature and the impact of literature on science.

English 385. Contemporary Literature. A seminar approach study of literature written in the present and recent past—within the lifetimes of students enrolled in the course. Several genres may be offered: novels, short fiction, poetry, memoir, personal essay, creative nonfiction, story-cycles, etc.

English 390. Junior English Seminar. A focused seminar style survey course that examines a literary period through a literary genre or representative authors. Possible examples are "Medieval Literature," "Nineteenth-Century American Novel," "Restoration and Eighteenth-Century Literature," "History of the English Language," or "Modernism." Possible literary genres may include satire, short story, novel, lyric poetry, epic poetry, drama, political essay, creative non-fiction, biography and memoir.

English 411. Language, Literature and Leadership: Advanced Writing and Speaking. Building on English 111 and English 211, this capstone course focuses on the moral and intellectual aspects of war as expressed in the literature of our profession: biographical, autobiographical and fictional accounts, along with the oratory of prominent public figures in times of national crisis. Rigorous written and oral assignments give students the opportunity to reflect on the inviolable bond that unites successful command with its moral, intellectual and emotional foundations. The text list comprises major canonical works of fiction, memoir and oratory that address the concreteness and complexity of war as well as the ethical issues of leadership.

English 411FX Language, Literature and Leadership: Advanced Writing and Speaking for French Language Exchange Cadets. Building on English 111 and English 211, this capstone course focuses on the moral and intellectual aspects of war as expressed in the literature of our profession: biographical, autobiographical and fictional accounts, along with the oratory of prominent public figures in times of national crisis. Rigorous written and oral assignments give students the opportunity to reflect on the inviolable bond that unites successful command with its moral, intellectual and emotional foundations. Designed for participants in the exchange programs in France and Canada. Texts are from major canonical works of fiction, memoir and oratory that address the concreteness and complexity of war and the ethical issues of leadership, as well as the language of diplomacy and international relations.

English 461. British Literature I: Beginnings to Romanticism. Surveys English poetry, drama and prose of such authors as Chaucer, Spenser, Shakespeare, Milton, Pope, Swift, Fielding and Johnson.

English 462. British Literature II: Romanticism to the Present. Surveys later English literature focusing on Romantic poetry, Victorian prose and poetry, and the Modern novels. Works are by such authors as Byron, Shelley, Austen, Bronte, Dickens, Hardy, Conrad, Tennyson, Browning, Yeats, Lawrence and Fowles.

English 470. American Literature: Introduction. Introduces American fiction, poetry, drama and prose. Representative authors might include Bradstreet, Melville, Dickinson, Douglass, Twain, Faulkner, Hemingway and Morrison.

English 475. Creative Writing. Examines techniques of creative writing. In a workshop atmosphere, students experiment with writing, focusing generally on a specific form such as the short story or poetry. The student's own work becomes the focus of discussion and attention.

English 484. Literature of War. Explores the treatment of war and issues related to military conflict in literature and other arts. Typical approaches are topical (The Warrior as Hero), cultural (American War Literature) or historical (Literature of the Vietnam War).

English 490. Senior English Seminar. Intensive seminar covering a literary period, literary genre or major author. Representative examples are "Coleridge and His Contemporaries," "The Victorian Age," and "American Literature Between the World Wars." Examples of literary genre include satire, short story novel, lyric poem and drama. Representative examples of major authors are Milton, Chaucer, Hawthorne, Hemingway, Hurston and O'Brien.

English 495. Special Topics. Selected topics in English. Previous topics have included "The Short Story," "Studies in the Gothic," "New Journalism," "The Theatre of the Absurd," and "Travel Writing and the Modern Imagination."

English 499. Independent Study. Study and research in literature, composition or creative writing for students who have demonstrated their ability for advanced study in regularly offered enrichment courses and for whom an appropriate enrichment course does not exist. Topics and meetings arranged with the instructor.

environmental engineering major

Contaminated water, dirty air, bulging landfills, hazardous waste disposal and contamination clean-up are environmental concerns which are growing in importance each day. The entire country is recognizing the importance of cleaning up past environmental contamination and preventing future pollution from occurring. The environmental engineering major offers students a broad environmental engineering education. Students in this major will get an understanding of the significant environmental problems facing this country and the Air Force. Course work will include how current environmental problems were created, the impacts of existing problems, how to correct existing contamination, and how to prevent future contamination from occurring.

If you like science and mathematics and are interested in improving and maintaining our environment, then perhaps environmental engineering is the major for you. The curriculum at the Academy provides a well-balanced program stressing the fundamentals of the environmental engineering profession. Our environmental engineering major is one of a handful of programs accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 - telephone: (410) 347-7700. Upon graduation you earn a Bachelor of Science in environmental engineering.

The environmental engineering major prepares students to be future Air Force leaders committed to improving and maintaining our environment. The degree has direct applications to Air Force career fields. A graduate with an environmental engineering degree is eligible for a civil engineer, general engineer, bioenvironmental engineer, research engineer or flying Air Force Specialty Code.

The goal of the environmental engineering program is to prepare students to become leaders of character who:

- Possess breadth of integrated, fundamental knowledge in the basic sciences, engineering, the humanities and social sciences; and broad knowledge in civil engineering.
- Can communicate effectively.
- Demonstrate leadership and can work effectively with others.
- Are independent, lifelong learners.
- Can apply their knowledge and skills to frame and solve Air Force civil and environmental engineering problems.
- Understand their ethical and professional responsibilities as embodied in the Air Force Core Values.
- Can function effectively in contingency operations.

Upon completion of the environmental engineering program each graduate shall demonstrate satisfactory:

- Application of the fundamental concepts of environmental engineering to solve engineering problems.
- Laboratory techniques including design of experiments, procedures, recording and analysis.
- Engineering design skills, including construction processes.
- Use of contemporary civil engineering analysis, design and test tools.
- Written and oral communication skills.
- Knowledge of ethical and professional responsibilities.
- Depth of knowledge and skills in environmental engineering and breadth of knowledge and skills in civil engineering, computers, mathematics and other disciplines to effectively identify and solve the types of complex, multidisciplinary problems they will face as Air Force environmental and civil engineers.
- Knowledge of the benefits and the skills needed to engage in life-long learning.
- Ability to be effective multidisciplinary team members.
- Skills to be independent learners while knowing when to seek help.
- Knowledge of the role of Air Force engineering officers in our global society.
- Knowledge of contemporary social, economic, political, military and engineering issues.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Academy Opt/BasSci Opt	Astro Engr 410
Civ Engr 330	Aero Engr 315	Civ Engr 351 (Summer)
Civ Engr 362	Beh Sci 310	Civ Engr 369
Econ 201	Biology 315	Civ Engr 463
English 211	Civ Engr 361	Civ Engr 467
Engr Mech 220	Civ Engr 368	Civ Engr 468
Law 220	Civ Engr 390	Civ Engr 469
Math 243	ECE 231	Civ Engr 480
Math 245	Engineering Opt	English 411
MSS 200	History 302	MSS 400
Physics 215	Math 356	Philos 310
Pol Sci 211	Sys Opt Engr 311	Soc Sci 412

ENVIRONMENTAL ENGINEERING (Civ Engr)
Offered by the Department of Civil and Environmental Engineering (DFCE).

Civ Engr 330. Elementary Structural Analysis. Static analysis of determinate structures: stresses and deformations in beams, trusses and frames.

Civ Engr 351. Civil Engineering Practices - Field Engineering. This two-phase course includes Operation Civil Engineering Air Force (OpsCEAF) and a three-week field experience at the Academy Field Engineering and Readiness Laboratory (FERL). Second-class cadets spend first period at a government facility working on a project in the civil engineering field. Participants will be scheduled for a second or third period summer leadership program. The three-week field experience introduces surveying, construction materials, design of concrete mixes and hands-on construction using metal, timber, asphalt and concrete and working knowledge of environmental systems. Students will construct various projects that they will design in later civil and environmental engineering courses. OpsCEAF is in lieu of Operation Air Force (Mil Tng 301).

Civ Engr 361. Fundamental Hydraulics. Application of the principles of incompressible fluid mechanics. Topics include: fluid properties, manometry, forces on submerged bodies, open channel flow and conduit flow. Impulse momentum, energy methods, Hardy-Cross method for balancing flows in distribution systems and sewer design are also covered.

Civ Engr 362. Introduction to Environmental Engineering. Fundamental theory, principles and preliminary design of unit operations in environmental engineering. Topics include air and water pollution, municipal and hazardous waste treatment, water chemistry, microbiology, mass balance, reactor theory and kinetics, and physical process theory.

Civ Engr 368. Ground and Surface Water Hydrology and Contaminant Transport. Comprehensive introduction to groundwater and surface water hydrology. Contaminant transport of hazardous chemicals in groundwater is also covered. Topics include: hazardous chemicals, environmental regulations, groundwater flow, well hydraulics, transport of contaminants in the subsurface environment, hydrologic cycle, surface water hydrology, hydrographs, rational method for storm water runoff, and storm water collection system design.

Civ Engr 369. Introduction to Air Pollution. In-depth introduction into air pollution covering such topics as the causes, sources and effects of air pollution. Topics include: legislative standards (ambient and source) for pollutants, regional and global air pollution issues, environmental health, indoor air pollution, noise, air pollution instrumentation and gas flow measurements, basic meteorology and dispersion modeling. The course work involves several laboratory exercises.

Civ Engr 390. Introduction to Soil Mechanics. Engineering properties of soils, soil classification, permeability, consolidation, compaction, shear strength and applications to engineering design. Soils laboratories and reports.

Civ Engr 405. Civil Engineering Seminar. Designed to give civil engineering majors the opportunity to synthesize and apply the concepts they have learned throughout their undergraduate education. Topics discussed include engineering ethics and those that students may encounter in the Air Force after graduation.

Civ Engr 463. Wastewater Treatment Plant Design. Design of facilities for physical, chemical and biological treatment of wastewater, and treatment and disposal of sludge. Coverage of advanced wastewater treatment and land treatment systems. Laboratory exercises analyzing raw sewage with data being used for the design processes.

Civ Engr 467. Water Treatment Principles and Design. Design of unit operations for coagulation, sedimentation, filtration and disinfection for treatment of drinking water. Introduces the chemistry of drinking water treatment processes. Use of unit operations to design treatment solutions to contemporary environmental problems. Topics include the design of ion exchange, reverse osmosis, chemical precipitation and selected hazardous waste disposal problems.

Civ Engr 468. Solid and Hazardous Waste Facilities Design. Design and analysis of solid and hazardous waste management systems including collection, transport, processing, resource recovery and disposal. Hazardous waste regulations, treatment and site cleanup are addressed.

Civ Engr 469. Design of Air Pollution Controls. Modeling and predicting the effects of air pollution and the design of the facilities for air pollution control. The designs of electrostatic precipitators, cyclones, bag houses and other methods for the control of air contaminants are addressed.

Civ Engr 480. Project Management and Contract Administration. This is the final course in the civil and environmental engineering capstone sequence. First-class cadets integrate discipline-specific design work from previous courses through a semester project. Students take an owner's project requirements through stages of scope definition, budgeting and planning, conceptual design, scheduling and construction contract administration. Students apply engineering standards and consider realistic issues including engineering economics, constructability, environmental requirements, sustainability and safety. Addresses and applies management topics and concepts of planning, organizing, leading and controlling in the context of a capstone engineering project. Concludes with a project competition involving construction industry professionals.

Civ Engr 499. Independent Study. Individual study and research in an advanced civil engineering topic approved by the department head.

foreign area studies major

Foreign area studies is the interdisciplinary study of one of six geo-cultural regions of the globe. Each program centers on foreign language, history, political science, economics, geospatial science and cultural coursework in a region of specialization, as well as a comparative framework for understanding cross-cultural dynamics. The academic program leads to a Bachelor of Science in foreign area studies; coursework focuses on either African, Asian, European, Latin American, Middle Eastern or Slavic Area Studies. Foreign Area Studies majors will select a disciplinary emphasis (economics, history, geospatial science or political science) which will determine which methods course, capstone course and electives they take. Students double majoring in MSS and foreign area studies will take MSS 379 and MSS 498 for their primary track research methods and integrating experience requirements. In addition, foreign area studies majors may earn an academic minor in a foreign language.

U.S. national security strategy, since the end of the Cold War, has shifted from a policy of bi-polar containment to strategies of global engagement, partnership, expanded mutual international security responsibilities and a war on terrorism. The Air Force's strategies entail a variety of new roles and missions aimed at promoting regional stability, rendering humanitarian assistance, encouraging emerging democracies, gathering intelligence, and projecting and applying air power when necessary. Today's officers, from all Air Force career fields and specialties will find themselves globally engaged, and such global engagement requires global skills. The foreign area studies major is designed to give future officers broad-based, foreign area-related skills for worldwide service commitments.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt
Econ 201	Beh Sci 310	Astro Engr 410
English 211	Biology 315	Econ 301
Engr Mech 220	ECE 315	English 411
For Lang 3	For Lang 5	Integrating Experience
For Lang 4	For Lang 6	Mgt 400
History 302	Math 300	MSS 400
Law 220	Philos 310	Regional Econ
MSS 200	Pol Sci 394	Regional Pol Sci
Physics 215	Regional History 1	Regional/Comp Econ
Pol Sci 211	Regional History 2	Soc Sci 412
Regional Geo	Research Methods	Sys Opt

FOREIGN AREA STUDIES (For Ar Stu)
Offered by the Departments of Economics and Geosciences (DFEG), Foreign Languages (DFF), History (DFH) and Political Sciences (DFPS).

For Ar Stu 400. Summer Foreign Language Immersion. Intensive foreign language and culture study at an accredited foreign university or language institute. Students must take the Defense Language Proficiency Test (DLPT) prior to departure and within 60 days after program completion earn a "P" grade. Course counts toward the foreign language minor.

For Ar Stu 401. Summer Foreign Language Immersion. Intensive foreign language and culture study at an accredited foreign university or language institute for cadets participating in summer foreign language immersion for a second time and received credit for For Ar Stu 400. Students must take the Defense Language Proficiency Test (DLPT) prior to departure and within 60 days after program completion earn a "P" grade. Course counts toward the foreign language minor.

For Ar Stu 410. Model Arab League (MAL). Interdepartmental, interdisciplinary seminar on contemporary issues on the Middle East, preparing foreign area studies majors for regional or national level competitions of the MAL. Specialists from various departments introduce historical, geographical, political, socioeconomic, cultural, linguistic and literary factors to enhance understanding of a specific region or nation of the Middle East. In addition, enrollees will learn parliamentary and forensic procedures. Portions of the course may be taught in Arabic.

For Ar Stu 415. Advanced Model Arab League (AMAL). Advanced interdepartmental, interdisciplinary seminar on contemporary issues on the Middle East, preparing students for regional or national-level competitions of the MAL. Specialists from various departments introduce historical, geographical, political, socioeconomic, linguistic and literary factors to enhance understanding of a specific region or nation of the Middle East. In addition, enrollees will serve as class leaders and mentors for first-time students of For Ar Stu 410, Basic Model Arab League. Enrollees of For Ar Stu 415 will serve as focal points during the drafting and presentation of point papers and resolutions during the model competitions.

For Ar Stu 420. Model Organization of American States (MOAS). Interdepartmental, interdisciplinary seminar on contemporary issues in Latin America, preparing foreign area studies majors for regional or national-level competitions of the MOAS. Specialists from various departments introduce historical, geographical, political, socioeconomic, cultural, linguistic and literary factors to enhance understanding of a specific region or country in Latin America. In addition, enrollees will learn parliamentary and forensic procedures. Portions of the course may be taught in Spanish.

For Ar Stu 425. Advanced Model Organization of American States (AMOAS). Advanced interdepartmental, interdisciplinary seminar on contemporary issues in Latin America, preparing students for regional or national-level competitions of the MOAS. Specialists from various departments introduce historical, geographical, political, socioeconomic, linguistic and literary factors to enhance understanding of a specific region or nation of Latin America. In addition, enrollees will serve as class leaders and mentors for first-time students of For Ar Stu 420, Basic Model Organization of American States. Enrollees of For Ar Stu 425 will serve as focal points during the drafting and presentation of point papers and resolutions during the model competitions.

For Ar Stu 430. Model African Union (MAU). Interdepartmental, interdisciplinary seminar on contemporary issues in Africa, preparing foreign area studies majors for regional or national-level competitions of the MAU. Specialists from various departments introduce historical, geographical, political, socioeconomic, cultural, linguistic and literary factors to enhance understanding of a specific region or country in Africa. In addition, enrollees will learn parliamentary and forensic procedures.

For Ar Stu 435. Advanced Model African Union (AMAU). Advanced interdepartmental, interdisciplinary seminar on contemporary issues in Africa, preparing students for regional or national-level competitions of the AMAU. Specialists from various departments introduce historical, geographical, political, socioeconomic, linguistic and literary factors to enhance understanding of a specific region or nation of Africa. In addition, enrollees will serve as class leaders and mentors for first-time students of For Ar Stu 430, Basic Model Organization of African Unity. Enrollees of For Ar Stu 435 will serve as focal points during the drafting and presentation of point papers and resolutions during the model competitions.

For Ar Stu 440. Model European Organization. Interdepartmental, interdisciplinary seminar on contemporary issues in Europe. Prepares students for regional or national-level competitions of the Model NATO and/or Model EU. Specialists from various departments introduce historical, geographical, political, socioeconomic, cultural and civil-military factors to enhance understanding of a specific country or countries in Western Europe. In addition, enrollees will learn parliamentary and forensic procedures.

For Ar Stu 445. Advanced Model North Atlantic Treaty Organization (AMNATO). Advanced interdepartmental, interdisciplinary seminar on contemporary North American and West European issues, preparing students for regional or national-level competitions of the MNATO. Specialists from various departments introduce historical, geographical, political, socioeconomic, linguistic and literary factors to enhance understanding of a specific region or nation of Europe. In addition, enrollees will serve as class leaders and mentors for first-time students of For Ar Stu 440, Basic Model North Atlantic Treaty Organization. Enrollees of For Ar Stu 445 will serve as focal points during the drafting and presentation of point papers and resolutions during the model competitions.

For Ar Stu 470. France in the Twentieth Century. Interdisciplinary course taught primarily in French, designed to give foreign area studies majors with a focus on West European and French language studies a better understanding of 20th century France. It combines expertise from the foreign language, political science, geospatial science and history departments to present major factors in the history, politics and culture of modern France and its unique position in the current international system.

For Ar Stu 495. Special Topics in Foreign Area Studies. Interdisciplinary course for foreign area studies majors (the following suffixes indicating geo-cultural region of specialization apply: "A"=Asia, "E"=Eastern Europe, "F"=Africa, "L"=Latin America, "M"=Middle East, "S"=Russia or Slavic regions, "W"=Western Europe). Cultural, literary, linguistic, historical, political, social, economic, geographical and other pertinent factors bearing on an understanding of the particular region involved are treated by specialists from relevant departments. Portions of the course may be taught in the relevant foreign language.

foreign language minor

You may study Arabic, Chinese, French, German, Japanese, Portuguese, Russian or Spanish—eight of the most important languages in the world. Within each language there is a broad spectrum of courses. The 100-200 level courses For Lang 321 and For Lang 322 are primarily skills development courses. The remaining courses are regarded as enhancement courses and are designed to develop a broader based appreciation of a particular culture, history and literature. These courses also provide additional opportunities to develop and refine your language skills.

Students majoring in any academic division or discipline may earn a foreign language minor provided they complete four language courses beyond the 100-level, in residence, in the same language with a grade of 'C' or better, complete the requirements for their major, and take the Defense Language Proficiency Test (DLPT) no later than two months prior to graduation. ForArStu 400 also fills a course requirement for the minor.

Beyond helping to understand culture and broadening your worldview, studying a foreign language can influence your military career. Our ever-expanding global Air Force mission not only demands increasing foreign language capability to support national security strategies, but also provides challenging assignment opportunities for those looking for experience and diversification. Moreover, someday you may want to return to the Academy as a language instructor, a position that is both rewarding and career enhancing while providing the opportunity to influence others toward becoming language-qualified Air Force officers. By speaking a foreign language, you become an "ambassador" helping to shape the opinions that others will have of our country and its armed forces...a crucial role in our increasingly interdependent world.

Learning a foreign language opens up an entirely new world. The study of languages helps further our understanding of other peoples, ourselves and of our own culture. This understanding is of even greater importance for the military leader than for the public at large.

FOREIGN LANGUAGES (For Lang)
Offered by the Department of Foreign Languages (DFF).

For Lang 131-132. Basic Sequence. Basic foreign language study. Introduction to the language, culture and civilization. Language Learning Center (LLC) supplements classroom instruction. Students are placed in the course on the basis of no prior language background or low placement examination scores. Must be taken sequentially. Students successfully completing For Lang 132 will enroll next in For Lang 221 (Arabic, Chinese, French, German, Japanese, Portuguese, Russian and Spanish).

For Lang 141-142. Accelerated Basic Sequence. Accelerated basic foreign language study. Foundational language, culture and civilization. LLC supplements classroom instruction. Students are placed in the course on the basis of placement examination scores. Must be taken sequentially. Students successfully completing For Lang 142 will enroll next in For Lang 221 (Arabic, Chinese, French, German, Japanese, Portuguese, Russian and Spanish).

For Lang 221. Refinement of Communication in the Target Language. Intensification of aural and reading comprehension. Student presentations and classroom discussions based on selected readings/topics in culture and civilization of language studied. LLC may supplement classroom instruction (Arabic, Chinese, French, German, Japanese, Portuguese, Russian and Spanish).

For Lang 222. Continued Refinement of Target Language. Emphasis on conversational practice and aural comprehension of contemporary spoken language. Student presentations and classroom discussions based on culture and civilization readings/topics in target language. LLC may supplement classroom instruction (Arabic, Chinese, French, German, Japanese, Portuguese, Russian and Spanish).

For Lang 321. A Capstone Communication Course. Designed to enhance the student's ability in the language and culture (Arabic, Chinese, French, German, Japanese, Portuguese, Russian and Spanish).

For Lang 322. A follow-on capstone communication course to For Lang 321. Designed to further hone the student's ability in the language and culture (Arabic, Chinese, French, German, Japanese, Portuguese, Russian and Spanish).

For Lang 365. Oral discussion of civilization, culture and contemporary issues (military, political, economic) of the country or countries concerned. Discussion is in the target language and is based on selected readings in that language (Arabic, Chinese, French, German, Japanese, Portuguese, Russian and Spanish).

For Lang 376. Survey of important writers, their works and influences on their societies. Students are provided cultural insights through literature. Discussions are conducted in the target language and based on selected literary works ranging from early times to contemporary periods (Arabic, Chinese, French, German, Japanese, Portuguese, Russian and Spanish).

For Lang 491. Language program with primary emphasis on the development of advanced foreign language reading skills via a variety of media. All classes are conducted in the target language, and all assignments must be completed in the target language (Arabic, Chinese, French, German, Japanese, Portuguese, Russian and Spanish).

For Lang 495. Special Topics. Selected topics in foreign languages.

For Lang 499. Independent Study. Individual study or research conducted on a tutorial basis. Study may be in any of the eight languages offered by the department. Topic or area of study/research must be approved by the department head.

Language Specific Courses

Chinese 492. Culture and Knowledge of the Chinese Military. Introduces the Chinese People's Liberation Army and its military service components. Students are introduced to contemporary military vocabulary and terminology from the Army, Navy and Air Force, with an emphasis on the Air Force. Students also learn to identify uniforms and recognize Chinese rank structure, as well as gain a basic understanding of Chinese aircraft, military organizations and military structure. Discussion topics include the role of women in the Chinese military, an introduction to Chinese military service academies, military law and discipline, and qualifications for Chinese military service. Course describes China's politico-military structure and examines China's philosophy and approach to ancient and contemporary warfare. Taught entirely in Chinese with course materials derived from authentic newspapers, magazines and other texts, as well as from audio and video clips.

French 372. Francophone Cultures. Taught in French on the Francophone movement and the cultures of selected French-speaking countries/regions other than France. In combination with faculty presentations and guidance, students will cooperatively research and discuss various French-speaking countries. Francophone Africa will figure prominently. Focuses on French influence over the historical, political and cultural aspects of those countries and the status of that influence today in relation to other regional and global systems.

French 492. French Air Force Academy Preparation. Language program with primary emphasis on the development of specific/required language skills and an examination of current cultural, military and political issues. All classes are conducted in French.

German 370. Three Hundred Years of German Immigration to America. More than seven million Germans have come to our shores through the centuries, and today some 60 million Americans—one in four—trace their heritage back to German ancestry. This course investigates the reasons why they came and where they settled; and how they were able to endure tremendous hardship only to succeed. Last, but not least, the course explores the economic, social, scientific, cultural and political contributions that these immigrants have made to the growth and success of the United States of America. All activities are conducted in German.

German 492. German Air Force Academy Preparation. Language program with primary emphasis on the development of specific/required language skills and an examination of current cultural, military and political issues. All classes are conducted in German, and all assignments must be completed in German.

Japanese 372. Japanese Society and Culture. The purpose of this course is to gain a basic knowledge of Japanese society and culture with particular attention to the areas of governmental organization, diplomatic relations, national defense policy and the constitution. Discussions are conducted in Japanese and based on selected readings in Japanese and/or English. Students learn about Japanese government and its constitution. Students compare what they have learned in other Japanese courses, as well as in courses covering the history, politics and law of other cultures, in order to gain a better understanding of human civilization as a whole. Class is "team taught" with an exchange officer from the Japan Air Self Defense Force. All activities are conducted in Japanese.

Japanese 492. Japanese Air Force Academy Preparation. Language program with primary emphasis on the development of specific/required language skills and an examination of current cultural, military and political issues. All classes are conducted in Japanese, and all assignments must be completed in Japanese.

Portuguese 150. Accelerated Basic Portuguese. Introduction to the language, culture and civilization. LLC supplements classroom instruction. Students are placed into the course on the basis of prior Spanish language background—level to be determined by the Department of Foreign Languages. Students successfully completing Portuguese 150 will enroll next in Portuguese 221.

Spanish 220. Basic Spanish II. Follow-on course for cadets starting in Spanish 131 and Spanish 132. Language Learning Center may supplement classroom instruction. Students who successfully complete Spanish 220 will enroll next in Spanish 221 the following fall.

Spanish 371. Current Events in the Spanish-Speaking World. Students experience a semester-long survey of significant current events in the Spanish-speaking world. They study and research the cultural, political, economic and historic factors that affect current reality. The course uses available press, television, radio broadcasts and other means such as the World Wide Web to carry out its objectives. Most of the activities of this course are in seminar format, with emphasis placed on oral discussions and written production. All activities are conducted in Spanish.

Spanish 377. Introduction to Literature in Latin America. Primary focus is a survey of important Latin American writers, their works and influences on their societies. Students are provided cultural insights through literature. Discussion and classes are conducted in Spanish and are based on literary works ranging from early times to contemporary periods. All classes are conducted and all assignments must be completed in Spanish.

Spanish 492A. Spanish Air Force Academy Preparation. Language program with primary emphasis on the development of specific/required language skills and an examination of current cultural, military and political issues. All classes are conducted in Spanish, and all assignments must be completed in Spanish.

Spanish 492B. Chilean Air Force Academy Preparation. Language program with primary emphasis on the development of specific/required language skills and an examination of current cultural, military and political issues. All classes are conducted in the target language, and all assignments must be completed in the target language.

general engineering major

The general engineering major is a divisional major incorporating the engineering disciplines of aeronautical, astronautical, civil, computer, electrical, environmental engineering, engineering mechanics and systems engineering. This divisional program is recommended for students who wish to major in engineering but prefer a broad, flexible curriculum with a high degree of individual choice. This program is an alternative for students already declared in an engineering disciplinary major, who, for a variety of reasons, find the divisional approach more suited to fulfilling graduation requirements.

The Academy's general engineering curriculum will not immediately prepare graduates to pursue an advanced degree in a specific engineering discipline. The general engineer may first be required to obtain an undergraduate degree from another university. Most universities require at least one year academic residence before granting a degree from their institutions. Some universities do not require an accredited undergraduate degree, but additional undergraduate work is usually necessary before acceptance into a graduate program.

The Academy's curriculum provides students the maximum flexibility to selectively structure their academic program to individual preferences. The program, however, is not accredited by ABET, Inc. A Bachelor of Science degree in general engineering is awarded upon completion of all requirements.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt
Econ 201	Beh Sci 310	Astro Engr 410
English 211	Biology 315	English 411
Engr Mech 220	ECE 231	Engr/Bas Sci Opt 2
Engr Opt 1	Engr Opt 3	Engr Opt 6
Engr Opt 2	Engr Opt 4	Engr Opt 7
Law 220	Engr Opt 5	Engr Opt 8
Math 243	Engr/Bas Sci Opt 1	Mgt 400
Math 245	History 302	MSS 400
MSS 200	Math 356	Soc Sci 412
Physics 215	Philos 310	
Pol Sci 211	S/T Energy Sys Opt	

ENGINEERING (Engr)
Offered by various departments within the engineering divisions.

Engr 101. Introduction to Air Force Engineering. Introduces the Academy engineering disciplines in the context of the engineering design process. Students work in teams, guided by the engineering method (an integrated decision-making process) and the system-design approach, to create solutions to real Air Force problems. They will employ modern computational tools to explore design alternatives and communicate their design solutions.

Engr 311. Electrical Power Systems. Applications of the principles of energy conversion to electrical power systems. Generation, transmission, distribution and use of electrical energy in ground- and aircraft-based systems. Topics include single- and three-phase AC power, single- and three-phase AC motors, transformers, transmission line modeling, AC to DC power conversion and DC motors.

Engr 341. Linear Systems Analysis and Design. Analysis and design of linear systems. Includes modeling of electrical and mechanical systems; characterization of physical systems using linear, constant-coefficient differential equations; and state-space models; convolution using Laplace and Fourier Transform techniques; identification of system response using frequency response and Bode plots; specification of design criteria in the s-domain; and modification of system parameters to satisfy design requirements. MATLAB™ and Simulink™ are introduced as simulation tools and as a computer interface for analysis and design.

Engr 342. Linear Control System Analysis and Design. Formulation and analysis of the linear control problem by transform methods. Synthesis of linear control systems emphasizing the root locus and Bode methods. Includes laboratory analysis and synthesis with real hardware and/or MATLAB™ simulation.

Engr 400. Divisional Seminar. Interdisciplinary study of engineering concepts, with emphasis on applications of fundamental principles. Includes case study, research, preparation and presentation of at least one major paper.

Engr 401. Engineering Divisional Core Substitute. This course can only be awarded for coursework accomplished during a semester of study abroad (CSSAP), international exchange (CSEAP) or service academy exchange (SAEP). With applicable department head or division chair approval, this course may fulfill the core requirement for Astro Engr 410, Aero Engr 315 or the science and technology energy/systems option.

Engr 402. Professional Engineering Development. Review of mathematics, chemistry, mechanics of materials, statics, dynamics, electrical circuits, thermodynamics, heat transfer, fluid mechanics and engineering economics in preparation for the national Engineer-in-Training exam administered at the end of the course by the state of Colorado. A fee must be paid by the student to take the exam; therefore, taking the exam is not required.

Engr 443. Advanced Control Theory and Design. Introduction to advanced control techniques. Topics include state-space fundamentals, state feedback control, optimal control methods, estimation theory and non-linear controls topics. Methods are applied to the design of control systems for aircraft and spacecraft. MATLAB™/Simulink™ will be employed in three design projects.

Engr 495. Special Topics in Engineering. Selected topics in engineering, administered by various engineering departments.

geospatial science major

The geospatial science program emphasizes learning about diverse cultures, physical landscapes and geospatial tools that expeditionary Air Force officers use. This major offers a diverse and challenging program focusing on contemporary world issues. A flexible curriculum has been carefully designed to permit either an in-depth or cross-disciplinary approach to the study of geospatial science, maximizing a student's ability to design his/her academic program beyond the core disciplinary requirements. Course offerings within the discipline represent a broad cross-section of the key geospatial science sub-fields including physical, human and regional geography, as well as state-of-the-art geographic information processing methods such as digital image processing and geographic information systems. Furthermore, students wishing to complement their major in geospatial science with a foreign language minor will be able to achieve both without carrying an academic course overload.

The geospatial science major provides excellent preparation for any assignment in the Expeditionary Air Force. The major also helps students develop international insight and cultural understanding of the battle space. Most geospatial science majors become pilots or intelligence officers. Many intelligence officers progress to become foreign area officers or international affairs specialists.

The goal of the geospatial science program is to produce leaders of character who:

- Effectively communicate spatial information.
- Analyze the Earth's physical form, processes and biota.
- Synthesize the spatial characteristics, distribution, cultural differences and interactions of human populations.
- Synthesize how relationships between humans and the physical environment impact the battle space.
- Solve ill-defined geospatial problems.

Students excelling in this program are eligible to compete for scholarships to graduate school. These include not only the prestigious national scholarships, such as the Rhodes, Fulbright and Marshall, but the USAFA Graduate Scholarship Program, in which graduates are sponsored by the Air Force Institute of Technology to earn their master's degree from a civilian institution.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Advanced Literacy Opt	Academy Opt
Econ 201	Aero Engr 315	Advanced Literacy Opt
English 211	Beh Sci 310	Astro Engr 410
Engr Mech 220	Biology 315	Cognate Elective
For Lang 3	ECE 315	Cognate Elective
For Lang 4	Geo 351	Cognate Elective
Geo 310	Geo 370	English 411
Geo 350	Geo 382	Geo 490
Law 220	History 302	Geo 498
MSS 200	Math 300	Mgt 400
Physics 215	Philos 310	MSS 400
Pol Sci 211	Soc Sci Div Opt	Soc Sci 412

GEOSPATIAL SCIENCE (Geo)
Offered by the Department of Economics and Geosciences (DFEG).

Geo 250. Human Geography. Designed to acquaint cadets with geography in general and its human aspects in particular. Cadets broaden their understanding of the complex relationships between humans and the environment and specifically human movement, language, religion, race, economic activities and urban development. Each cadet is encouraged to develop a strong appreciation and comprehension of the never-ending and dynamic processes that are continually operating on the Earth and its human occupants.

Geo 310. Geospatial Information Analysis. Prepares cadets with the basic tools necessary to make decisions with geographic (geospatial) information. It introduces data sources and collection techniques (e.g. use of remote sensing and GPS). Students learn methods to transform data into geospatial intelligence appropriate for decision making. Military and civilian applications of Geographic Information Systems (GIS) technology are examined in case studies and students complete projects to demonstrate the ability to solve an ill-defined spatial problem and make recommendations to a decision maker.

Geo 351. Introduction to Physical Geography. Study of the Earth system (atmosphere, hydrosphere, biosphere and lithosphere). Focuses on the spatial distributions within the system, the use of maps to explain the distributions, origins and processes shaping the Earth's surface, and the influence of humans on the Earth system.

Geo 353. Geomorphology. Analysis of dynamic processes, distribution and structure of the Earth's physical features. Focuses on fundamental concepts of physical geology, climate, soils and vegetation.

Geo 355. Field Experience in the Geosciences. Provides the opportunity for advanced learning in a specific aspect of the geosciences. Students apply prerequisite knowledge to a field-based, practical problem. Combines classroom instruction and problem design with extensive field experiences addressing the problem. Topics/study sites vary and are determined by the course director.

Geo 360. Environmental Geography. Focuses on problems of population growth, planet sustainability and environmental change. Also examines geographic aspects of resource management, conservation and land use. Environmental issues unique to Colorado are discussed.

Geo 370. Military Geography. Analysis of the significant influence geography exerts on military operations, war and national security. Examines how the physical, cultural, political and economic dimensions of geography and meteorology affect the planning and execution of today's military operations.

Geo 382. Remote Sensing and Imagery Analysis. Mechanisms for exploiting the electromagnetic radiation spectrum are investigated using particle and wave theory equations. Digital image processing techniques are presented and applied using the Applied Geography Laboratory facilities and raster data from commercial space borne sensing systems.

Geo 410. Advanced Geospatial Analysis. Equips students with advanced analytical skills to understand and resolve complex geospatial problems. Discussion and projects integrate advanced geospatial analysis techniques with real world data to address problems similar to those officers may encounter in the operational Air Force. Building on knowledge and expertise learned in Geospatial Information Analysis (Geo 310), students integrate theoretical geoscience concepts with data analysis and information-extraction techniques.

Geo 470. Geography of Europe and Russia. Geographical analysis of the physical and cultural landscapes of Western and Central Europe, Russia, as well as former Soviet states in Europe. Topical analyses include demography, language, religion, industry and geopolitics.

Geo 471. Geography of the Americas. Geographical analysis of the physical and cultural landscapes of North, Middle and South America. Focuses on the regional distribution of resources and land uses, economic structure, industrial development, settlement patterns, demographics and other population characteristics.

Geo 475. Geography of Asia. Geographical analysis of the physical and cultural landscapes of East, Central and Southeast Asia. Focuses on the regional distribution of resources, economic structure, industrial strength, settlement patterns and patterns of population growth.

Geo 480. Geography of the Middle East and Africa. Geographic analysis of the physical, cultural, economic and political diversity of the Middle East and Africa. Topical analyses include resources, demography, language, religion, industry and geopolitics.

Geo 482. Advanced Remote Sensing. Explores advanced analysis techniques for extracting information from satellite imagery. Imagery of various spatial and spectral scales is used, including thermal-infrared and radar imagery. The goal is to provide students with experience in tackling geospatial problems with remote sensing data—from development of the questions, to identification of the necessary data, and finally selection and execution of appropriate analysis techniques. Includes several case studies.

Geo 490. Global Cultural Awareness. Introduces students to major ideas, institutions and events that shape human cultures and societies. Uses a comparative approach to the study of cultures around the world, focusing particularly on religions, languages, traditions, ways of life and perceptions. The major objective is for students to be able to compare and appreciate global cultures in a spatial context. Enables students to interact more sensitively and effectively with people from other cultures in today's Expeditionary Air Force.

Geo 495. Special Topics. Selected topics in geospatial science.

Geo 498. Geographic Interpretation, Analysis and Integration. Capstone course in geospatial science. Using field experiences and case studies, the course assesses the student's ability to integrate and synthesize geoscience knowledge, analytical techniques and research methods in geospatial science and cognate disciplines as they apply to the support of the battle space.

Geo 499. Independent Study. Independent research under the direction of a faculty member.

history major

An understanding of history is a critical component to the training of capable, educated officers. The knowledge gained and the perspective developed are important to the education of the professional Air Force officer. The study of history involves critical thinking, analysis, writing and oral presentations—all essential skills for any Air Force officer. In addition, the study of foreign cultures, evolution of technology and military heritage can directly relate to many duty situations. History also provides a natural forum for discussion of great leaders, past and present, and these insights are invaluable to any future Air Force officer.

The history major provides an exceptional degree of flexibility allowing you to plan a diverse study of history or establish a particular academic niche.

Those students who take at least four courses of military history (in addition to the core) or at least four courses of American history (beyond History 351 and 352) may apply through the Department of History for these respective designations before the registration deadline in the fall semester of their first-class year.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt
Econ 201	Aerospace History Opt	Astro Engr 410
English 211	Area History Opt	English 411
Engr Mech 220	Beh Sci 310	History Capstone
For Lang 3	Biology 315	History Opt 2
For Lang 4	ECE 315	History Opt 3
History 302	Geo 310	History Opt 4
History 351	History 330	History Opt 5
Law 220	History 352	Mgt 400
MSS 200	History Opt 1	MSS 400
Physics 215	Math 300	Open Academic Opt
Pol Sci 211	Philos 310	Soc Sci 412

HISTORY (History)
Offered by the Department of History (DFH).

History 101. Modern World History. Surveys major pre-modern civilizations and the development and diffusion of modern cultures throughout the world. Examines the interaction of traditional and modern cultures culminating with the turbulent 20th century and highlights the global impact of political, religious, ideological, military, economic and social developments.

History 302. Introduction to Military History. Surveys the history of Western warfare from the age of gunpowder to the present. Concentrates on the evolving methods and theories of warfare in Europe and the U.S. Emphasizes how political, social, economic and technological factors have combined to shape various changes and continuities in the nature of Western warfare.

History 320. History of Technology and Warfare. Examines the relationship of technology to warfare on land, at sea and in the air from antiquity to the present. Investigates the roots of weapons technology in the social, political and engineering context. Affords special treatment to the impact of engineering and the industrial revolution on the development of technology and subsequent impacts on warfare. The interrelationship of technology, tactics and strategy provides the thematic framework. Devotes several lessons to case studies of battles and campaigns that illustrate significant developments.

History 325. History of Christianity. Surveys the history of the Christian church from its ancient Jewish roots to the modern period. Examines the significant changes and continuities of Christianity since its founding. Topics include the ancient Jewish kingdoms, the church's beginning under Jesus and the apostles, the Age of Martyrs, the writings of the Church Fathers, the Christianization of the Roman Empire, the medieval civilization of Christendom, the Crusades, the Reformation, the effects of the Enlightenment, and the global spread of Christianity.

History 330. Historiography and Methodology. A history practicum that is the "how to" course for history majors. The course begins with a survey of historiography, or "the history of historical writing." Most of the course is devoted to practicing historical methodology (historical "detective work," critical analysis of evidence, asking and answering historical questions, and oral and written presentation skills). Each student will write and present a major research paper on a topic of their choosing.

History 332. History of U.S. Foreign Relations. Examines major developments in U.S. foreign relations from colonial times to the present. Focuses on the myriad of ways Americans interacted with people and nations around the world, including Africa, East Asia, Europe, Latin America, the Middle East and Russia. Specific consideration is given to the roles of social issues, economic interests and security concerns in explaining both official foreign policy and unofficial relationships. Coursework centers on classroom lecture and discussion and extensive analysis of interpretive essays and primary documents.

History 335. History of the American West. Examines the special contributions of the American West to the evolution of the United States. Throughout their history Americans have been intrigued and fascinated by their vast frontier. The American frontier served as a granary and a safety valve while helping to shape the American character. The course explores the validity of Frederick Jackson Turner's frontier thesis and the events and ideas that made the West unique.

History 336. History of the American South. Examines the special contributions of the South to the evolution of the U.S. and analyzes the major themes of Southern history in the 18th, 19th, and 20th centuries. Emphasis is placed on understanding ideas and values, especially as the people of the South have perceived them and their role in Southern society. Focuses on how Southern society evolved differently from the rest of the U.S., and seemingly over a century and a half merged with mainstream America while maintaining a unique identity.

History 338. Colonial Warfare. Comprehensively examines the competition and conflicts that resulted from European explorations and conquests of the 15th, 16th, and 17th centuries that erupted into serial warfare in the 18th century. These conflicts exposed all sides to different modes of warfare that shaped future combat. Examines the causes for these wars (with an emphasis on the conflicts in North America), the changes in tactics and strategy that resulted from the clash of cultures, and the ideologies that sprang from colonization.

History 339. The American Civil War. Multidimensional examination of the causes, conduct and legacy of the American Civil War. In-depth analysis of Southern sectionalism precedes a comprehensive discussion of all aspects of the war itself: military, economic, cultural, social, political, technological and ideological. A description of the short- and long-term effects of the war on the American military establishment concludes the course.

History 340. History of Colonial Latin America. Examines the Native American, Iberian and African origins of colonial civilization, with special emphasis on the colonial society that evolved after the Spanish and Portuguese conquests. Examines the nature of pre-Columbian societies, colonial government, labor systems, landholding patterns, the role of the church in society and the Latin American wars of independence.

History 341. History of Modern Latin America. Examines the post-1825 period of Latin American history. Explains aftermath of the wars of independence, the formation of nation-states, and the emergence of Latin American identities throughout the 19th century. Treats major issues of the 20th century, including political change, industrialization, foreign influence, military institutions, social and demographic pressures and the U.S. role in different national contexts.

History 342. History of Traditional Asia. Surveys the major political, economic and sociocultural developments in Asia (primarily China, India, Japan and Southeast Asia) from prehistoric times to the arrival of the Europeans in the 16th century. Explores the major themes of the traditional foundations of Asia, change and continuity, the structure of the traditional Asian world order, and the impact of contact with the European maritime powers.

History 343. History of Modern Asia. Surveys the major political, economic and sociocultural developments in Asia (primarily China, India, Japan and Southeast Asia) from roughly the 16th century to the present day. Explores the major themes of the traditional foundations of Asia, the impact of Western imperialism in Asia, the impact of Western ideologies on Asian thought, the importance of technological change, and the significance of political, economic and cultural leaders.

History 344. Foundations of European History. How did the European continent rise from being a cultural and intellectual backwater to become a political and military powerhouse that eventually extended its influence across the globe? What powerful connections link the ancient world with the present government, religion and culture of the West? Through this survey of European history from Antiquity to 1789, discover how the continent was transformed. Analyzes major aspects of European development, including ancient Greece, the Roman Republic and Roman Empire, the advent of Christianity, feudalism, the Renaissance, the Reformation, the rise of the nation-state and the Enlightenment.

History 345. Modern European History. Surveys the political, social and cultural history of modern Europe, beginning with the French Revolution, and continuing through both world wars to contemporary Europe. Major themes include Napoleonic Europe, the industrial revolutions, the European nationalist movements, World War I, the inter-war years, World War II, the decline of the European empires, the Cold War and the demise of monolithic regimes. Concludes with a study of the legacies of the Cold War and the advent of the European Union.

History 346. History of Russia. Surveys Russian and inner Eurasian domestic and foreign affairs from the 9th century to 1917. Emphasizes the ways in which Eastern, Western and native influences promoted continuity within the Tsarist Russian state, to include: autocracy, church-state relations, imperialism and non-Russian peoples, great power status, foreign power intervention and modernization.

History 347. History of Modern Russia. Surveys domestic and foreign affairs from 1900 to the present. Focuses on the dynamics of the Russian Empire's society and government under the last tsar through the Bolshevik seizure of power. Reviews communist attempts and the final failure to develop a legitimate Soviet state resulting in fragmentation into 15 independent nations, including the Russian Federation. Gives special attention to the unique synthesis of military and economic power leading to "superpower" status and its eventual demise.

History 351. The Foundations of Modern America. Examines the political, intellectual, social and economic origins and development of the U.S. from the first settlements through Reconstruction (1865-1877). Emphasizes the importance of the colonial experience, the Revolution, the national period, the growth of democracy, westward expansion and the Civil War and Reconstruction in shaping modern America.

History 352. The History of Modern America. Continues examining the political, intellectual, social and economic development of the U.S. from the late 19th century to the present. Concentrates on the growth of the U.S. as a major economic and political power. Gives special attention to the impact of industrialization, urbanization, immigration, reform movements, mass culture, domestic economic fluctuations, governmental expansion, and military involvements during the 20th century.

History 361. Genesis of Flight through World War II. History of the air weapon with primary emphasis on leadership and tactics as they evolved prior to 1947. Covers global development of military airpower, stressing the constant interplay among personalities, institutions, theories, technology, combat experience and evolving doctrine.

History 363. Unconventional Warfare. Surveys the evolution, theory and practice of insurgent and revolutionary warfare throughout the world from the 17th century to the present. Special attention is given to the 20th century. Examines counterinsurgency operations in various areas and circumstances.

History 367. Ancient, Medieval and Early Modern Warfare. A broad survey providing a deeper background for the understanding of modern war. The course begins with the rise of organized warfare in the Near East, focusing on the Assyrian and Persian military systems, traces the development and operations of the Greek and Roman military systems, and then moves to the evolution of feudal warfare and its eventual metamorphosis into the earliest forms of modern war, culminating in the Thirty Years War. Moslem, Byzantine, Chinese and Japanese forms of warfare are also addressed to complete a general survey of the roots of modern warfare.

History 368. World War II. Studies the largest conflict in human history. Includes a detailed analysis of the causes, ideologies, strategies, technologies and campaigns of the war. Examines the economic and social implications of the war on various nation states. Major themes include the role of military and political leadership, the nature of coalition warfare, and the role of the modern officer in combat.

History 369. Limited War in the 20th Century: Korea and Vietnam. America's wars in Korea and Vietnam established new patterns of limited warfare. Within the contexts of the superpower system and a nuclear arms race, the U.S. tried to fight wars that would achieve limited aims with limited means. Examines the Korean and Vietnam Wars as part of larger patterns of contemporary history. Special emphasis on the role of technology, foreign policy, domestic social and political climates, and the long-term implications of American strategy and policymaking.

History 370. World War I. Detailed analysis of the epochal event of the 20th century. Explores the role of ideology, military and social doctrine, alliance systems and European militarism on the outbreak and conduct of total war in Europe. Details the disparate military environments of stalemate on the Western Front, deadlock on the high seas, and maneuver warfare on the Eastern Front illustrates the struggle between military doctrine and emerging technology. Special emphasis on the integration of air power and the emergence of modern paradigms for conducting warfare.

History 371. Airpower and Modern Warfare Since World War II. History of the air weapon with primary emphasis on leadership and tactics as they evolved since 1947. Covers global development of military airpower, stressing the constant interplay among personalities, institutions, theories, technology, combat experience and evolving doctrine.

History 372. Sea Power and Modern Warfare. History of sea weapons with primary emphasis on technology, tactics and leadership as they evolved from 1,000 B.C. to the present. World-wide treatment stresses the constant interplay among personalities, institutions, theories, technology, combat experience and evolving doctrine.

History 373. History of Sub-Saharan Africa. Surveys Sub-Saharan African history to essentially answer the question, "Why is Sub-Saharan Africa the way it is today?" Focuses on three eras—the pre-colonial period, the colonial period and the post-colonial period—and the great transitions between them. Helps students understand the influence of geograpy and climate, religion, warfare, disease, economics and trade, and domestic and international politics, as well as other forces, on African peoples and societies over time.

History 374. Foundations of Middle Eastern History. Introductory historical survey of early civilizations in the Middle East and North Africa from the dawn of civilization to the fall of Constantinople to the Ottoman Empire in 1453. Emphasizes the classical empires of the Near East, developments and contributions of Judaism and Christianity, the birth and spread of Islam, the impact of the Crusaders and Mongols on the region, and the rise to dominance of the "gunpowder empires."

History 375. Modern Middle Eastern History. Surveys domestic and foreign affairs of the Middle East and North Africa from the rise of the Ottoman Empire to the present. Emphasizes the impact of imperialism, nationalism, constitutionalism, modernization and reform. Analyzes independence movements of the 20th century, the Arab-Israeli conflict, the Zionist and Islamic fundamentalist movements, the Gulf War, and other contemporary trends, problems and challenges.

History 376. A History of Space Power: Conquest of the New Frontier. Surveys the history of space power with primary emphasis on the U.S. and Soviet space programs during the Cold War and beyond (ICBMs to satellites; the electronics revolution to manned space programs), and their origins in the German V-programs of World War II. Examines the interplay among leadership, politics, society, technology, the Air Force's ambivalent relationship with this new expression of military power, and associated doctrinal challenges.

History 381. Topics in Asian Military History. Survey of the military history of Asia. Examines the evolution of warfare in Asia, including the political, economic and social roles played by military forces, the influence of Western military science, and the impact of the global conflicts of the 20th century.

History 382. Topics in African Military History. Survey of the military history of Africa. Examines the evolution of warfare in Africa, including the political, economic and social roles played by military forces, the influence of Western military science, and the impact of the global conflicts of the 20th century.

History 383. Topics in Middle Eastern Military History. Survey of the military history of the Middle East. Examines the evolution of warfare in the Middle East, including the political, economic and social roles played by military forces, the influence of Western military science, and the impact of the global conflicts of the 20th century.

History 384. Topics in Latin American Military History. Survey of the military history of Latin America. Examines the evolution of warfare in Latin America, including the political, economic and social roles played by military forces, the influence of Western military science, and the impact of the global conflicts of the 20th century.

History 394. The American Way of War. Surveys the history of American warfare from the colonial period to the present. Focuses primarily on the nature of American warfare and addresses whether there is a peculiar American way of war. Addresses such issues as the American attitude toward war, civil-military relations, force structure, the role of professional leadership and the impact of technology.

History 457. History of Military Thought. Investigates the ideas of selected major military thinkers from the time of Machiavelli to the present. Emphasizes writers whose impact on evolving strategy and doctrine, whether on land, sea or in the air, has been most far-reaching.

History 480. Studies in American Civilization. Examines conflict and stability at various historical periods in American society, emphasizing such institutions as government, education, religion, the military, business, the family, media and sports. Focus changes each semester.

History 483. Great Americans. Examines the role of the individual in American history. Through the illuminating prism of biography, lives of selected prominent Americans are studied to understand the unique personal qualities that contributed to their success and to determine the extent to which individual actions impact the course of history. Features political, military, business, labor, scientific and literary figures.

History 495. Special Topics. Selected topics in history.

History 498. Global Dimensions of History. Examines the dynamic forces influential in shaping global history. Explores time, space (geography), politics, economics and society in the context of universal and world history. Devotes special attention to the impact of varying cultural perspectives upon individual historical understanding. Also explores the current process of globalization and its many challenges.

History 499. Independent Study. Reading and research in any recognized area of historical study. Areas selected by the instructor depend on student interest.

humanities major

The humanities major is a divisional major requiring 141 semester hours for graduation. The major includes courses from the departments of English and fine arts, foreign languages, history, military strategic studies and philosophy. A wide variety of elective options allows students the flexibility to tailor the major to individual interests. In addition, the divisional options make the major ideal for students who wish to minor in either Foreign Language or Philosophy.

Humanities majors confront fundamental questions of human existence. They enhance their reasoning ability, as well as their writing and speaking skills, by developing proficiency in critical and creative thought through an exploration of the ideas embodied in great works of Western thought, literature and art. The humanities major prepares students for graduate study and for a wide variety of career fields.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt
Econ 201	Beh Sci 310	Astro Engr 410
English 211	Biology 315	Divisional Opt
Engr Mech 220	Divisional Opt	Divisional Opt
For Lang 3	ECE 315	Divisional Opt
For Lang 4	English Opt	Divisional Opt
Geo 310	Fine Art Opt	English 411
History 302	History Opt	Mgt 400
Law 220	Math 300	MSS 400
MSS 200	MSS Opt	Soc Sci 412
Physics 215	Philos 310	
Pol Sci 211	Philos 390	

FINE ARTS (Fine Art)
Offered by the Department of English and Fine Arts (DFENG).

Fine Art 352. Art in History. Surveys world art from antiquity to the present. Studies the major periods, schools and styles of art, as well as biographies of important artists. Students apply various methods of studying major masterpieces across time, geography and cultures.

Fine Art 358. Music Appreciation. Surveys music in the Western world and studies basic elements, forms and styles in representative works by major composers. Emphasizes listening, understanding and appreciation. Knowledge or talent in music is not required.

Fine Art 359. Introduction to Drawing and Design. The first course for students with no practical art experience. Students with previous high school drawing experience and those already proficient in drawing should enroll instead in Fine Art 464, Painting and Printmaking. Assignments include hands-on class exercises that teach students to apply the principles of design to common design tasks. Students gain practical experience in sketching still life, landscape and figurative subjects. Students are expected to devote time outside of class to practicing the skills learned during class.

Fine Art 375. Introduction to Film Studies. A structured introduction to cinema which takes a thematic or chronological approach to the study of film as art form, with attention to developing an understanding of film grammar, terminology, narration, forms of genre and modes of production. Also includes a critical component introducing students to many of the central theoretical ideas about cinema that have dominated the field of film studies since the 1950s. Each film is viewed outside of class before it is discussed.

Fine Art 463. 3-D Studio Art: Clay and Sculpture. Introductory course to practical 3-D processes in art. Students plan and create projects using a variety of sculptural materials that may include: wire, wood, clay, plaster and other media.

Fine Art 464. 2-D Studio Art: Painting and Printmaking. A practical course in practical 2-D processes in art. Students learn watercolor and acrylic painting and complete several projects in each medium. Students also complete several etching and relief printmaking projects.

Fine Art 495. Special Topics. Selected special topics in fine arts.

Fine Art 499. Independent Study. Independent study in art or music. Subject and meetings arranged with the instructor.

HUMANITIES (Hum)
Offered by the Departments of the Humanities Division.

Hum 200. Introduction to the Humanities. Seminar-style interdisciplinary course with an introduction to the intellectual history of Western civilization through literature, philosophy, the fine arts, and the history of law and science. Aims to lay the foundation for further study in the disciplines of the humanities, to enhance integrated knowledge and critical thinking, and to prepare students for advanced study.

Hum 400. Humanities Seminar. Seminar-style interdisciplinary course focused on the history of Western civilization, through literature, the arts and philosophy. Related topics include the histories of law and science and their impact on trends in the humanities. This approach is invaluable for enhancing integrated knowledge and critical thinking and is excellent preparation for cadets wishing to pursue graduate studies. For those enrolled in the Academy Scholars Program (ASP) who completed Hum 200, they may take Hum 400 toward ASP requirements. Students enrolled in the ASP who did not take Hum 200 may elect to take Hum 400S.

Hum 401. Humanities Divisional Core Substitute. This course can only be awarded for coursework accomplished during a semester of study abroad (CSSAP), international exchange (CSEAP), or service academy exchange (SAEP). With applicable department head or division chair approval, it can fulfill the core requirement for English 411, MSS 415/416 or Philos 310.

Hum 430. The Holocaust. The subject of the Holocaust, the destruction of the Jews of Europe and others at the hands of the Nazis and their collaborators, is of great significance in the history of human civilization. The extensive documentation of this systematic genocide lends itself to the academic examination of critical lessons in the study of human history and behavior, as well as ethical issues. Through this investigation students can also understand what it means to be a responsible citizen and soldier.

Hum 461. Russian Literature. A study of representative Russian authors (such as Pushkin, Chekhov, Dostoevsky, Tolstoy, Sholokhov, Pasternak and Solzhenitsyn) in their historical and cultural setting and their impact on the shaping of the national character of the Russian people.

Hum 463. Far Eastern Literature. A historical survey and analysis of major literary works of the Far East with emphasis on China and Japan.

Hum 475. Army Heritage and Operations. Survey of the U.S. Army, its history and traditions, doctrine and tactics. Prepares students for commissioning as Army officers and attendance at the Army's Basic Officer Leader Course Phase II (BOLC II) by familiarizing them with the history and heritage of the Army; providing a basic understanding of fundamental Army operational and tactical doctrine; and introducing students to small unit leadership, doctrine, tactics, techniques and procedures (TTP) of company grade leadership – Troop Leading Procedures (TLP). Written assignments, land navigation and Tactical Exercise Without Troops (TEWT). Priority given to cadets with submitted written requests for Army Service Transfer (cross commissioning).

Hum 495. Special Topics. Selected topics in the humanities.

PHILOSOPHY (Philos)
Offered by the Department of Philosophy. (DFPY)

Philos 310. Ethics. A critical study of several major moral theories and their application to contemporary moral problems with special emphasis on the moral problems of the profession of arms. Highlights an officer's responsibilities to reason and act ethically; develop critical thinking skills; know civic, cultural and international contexts in which the U.S. military operates; and learn influential normative theories about ethics and the foundation of character.

Philos 311. War, Morality and the Military Profession. In-depth examination of the moral issues raised by the profession of arms. Presumes an understanding of moral theory, as a minimum: relativism, egoism, utilitarianism and deontology. May be taken as a sequel to or as a substitute for Philos 310 (with department approval) if the student has independently studied ethical theory.

Philos 330. Introduction to the Philosophy of Science. Analysis of the basic assumptions and principles of the sciences. Types of topics considered include the scientific method, scientific laws, theory construction, scientific explanation, probability, the relationship between the social sciences and the physical sciences, and the relationship between the sciences and the humanities, especially in the formation of values.

Philos 360. Applied Reasoning. Introduction to basic deductive and inductive applied logic. Includes analysis and evaluation of the notions of evidence and good arguments in fields such as law, medicine, science, engineering, behavioral and social sciences and military studies. Students concentrate on reasoning in a specific field of interest.

Philos 370. Introduction to Symbolic Logic. Advanced course in logic that examines propositional and predicate languages, model theory, quantifiers, proofs, identity theory and properties of logical systems.

Philos 382. American Philosophy. Examination of the philosophic background of Puritanism, the Revolutionary period, transcendentalism and pragmatism with special reference to the thought of major American philosophers such as Pierce, James, Royce, Santayana and Dewey.

Philos 390. Great Philosophers. In-depth study of some of the central Western philosophers and their systems of philosophy. Philosophers read include some of the following: Plato, Aristotle, Augustine, Aquinas, Descartes, Locke, Berkeley, Leibniz, Hume, Kant, Hegel, Schopenhauer and Nietzsche.

Philos 395. Philosophy of Law. Course serves as an introduction to legal philosophy and its relations to moral reasoning. Emphasizes the nature of law, its authority, its relations to morals, the controversies over judicial decision-making, the justification of states interfering with the liberty of its individual citizens, the various different or competing senses of "justice," the question of responsibility, and the justification of legal punishment.

Philos 401. Comparative Religion. A philosophical survey of selected world religions, possibly including "extinct" religions now known only through texts and other artifacts. Faith traditions to be surveyed in every offering of the course include Hinduism, Buddhism, Islam, Judaism and Christianity. Course syllabus lists additional traditions to be examined in a given semester.

Philos 402. Philosophy of Religion. Topics covered include concepts of the divine, grounds for belief in a deity, theories of salvation, the problem of evil, the roles of revelation and reason in religion, problems of religious language, and the role of religion in moral theory.

Philos 410. Medical Ethics. Ethics applied to biomedical issues using a seminar approach. Ethical problems considered include informed consent, refusal of treatment, suicide, killing and letting die, paternalism, allocation of health care, patient confidentiality, codes of medical ethics and specific case analyses.

Philos 495. Seminar in Philosophy. Selected topics in philosophy.

Philos 499. Independent Study. Philosophical research guided by an instructor.

legal studies major

The legal studies major provides a broad liberal arts background upon which a cadet at the Academy may build expertise in the study of law and its role and function in both American society and the international community. Increasingly complex legal considerations permeate every aspect of modern life in both the civilian and military environments. Students who choose the legal studies major will be able to develop the analytical skills that will permit them to identify, understand and resolve the complex legal issues which they will likely encounter after graduation. The legal studies major is not a "prelaw" major, but is designed to provide students an enhanced knowledge of the law as part of a broadly focused education.

The Department of Law and the legal studies major fall within the social sciences division. Students who elect to major in legal studies must complete 14 courses in addition to the required academic core; five of these must be upper-level courses offered by the Department of Law. In addition to the law courses, a legal studies major has discretion in selecting courses offered by the Departments of Behavioral Sciences and Leadership, Economics and Geosciences, English and Fine Arts, Foreign Languages, History, Management, Military Strategic Studies, Philosophy and Political Sciences. This program of study is designed to expose the student to a broad range of issues within the discipline of law. It provides a broad liberal arts background upon which an Air Force officer may build specialized expertise in an area of increasing relevance and importance.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt
Econ 201	Beh Sci 310	Astro Engr 410
English 211	Biology 315	English 411
Engr Mech 220	ECE 315	Law 421
For Lang 3	History 302	Law 485
For Lang 4	Law 331	Law Opt 4
Law 220	Law 351	Law Opt 5
Law 221	Law Opt 2	Mgt 400
Law Opt 1	Law Opt 3	MSS 400
MSS 200	Math 300	Soc Sci 412
Physics 215	Ops Rsch 310	Soc Sci/Hum Opt 1
Pol Sci 211	Philos 310	Soc Sci/Hum Opt 2

LAW (Law)
Offered by the Department of Law (DFL).

Law 220. Law for Air Force Officers. A core course introducing students to the legal knowledge and skills they will need as Air Force officers and educated citizens. Examines the nature of law and its role in American society and the military; provides an overview of the American civilian and military justice legal systems; examines selected foundational constitutional rights, particularly as they apply in the armed forces; and introduces substantive areas of the law that military officers likely will encounter in their personal and official capacities, including criminal law, civil law, military administrative law and the law of armed conflict.

Law 221. Legal Research, Writing and Advocacy. Following an introduction to the fundamentals of legal research and legal reasoning, students will do various exercises intended to enhance research skills, hone the ability to recognize and articulate legal issues, foster critical analysis and promote effective communication. Students also practice advocacy skills. The course culminates with the students preparing a legal memorandum or equivalent legal document. Students receive a fact scenario that presents an ill-defined issue of law. They will draft an appellate brief or equivalent document which they will use to advocate a position in oral argument.

Law 331. Criminal Law and Procedure. Examines selected crimes and defenses and focuses on how and why selected constitutional rights constrain the government and protect individual liberties in the context of criminal law and procedure. Skills emphasized include critical thinking, legal problem-solving, and oral and written communication.

Law 340. Business Law. In-depth study of the law governing U.S. commerce and business organizations. Emphasizes contracts, formation of business organizations and laws which regulate the workplace environment.

Law 351. U.S. Constitutional Law. In-depth analysis of selected provisions of the U.S. Constitution and Supreme Court decisions interpreting them. Topics include powers of the branches of the federal government, federal-state relations and individual rights as limitations on governmental power. Skills emphasized include critical thinking, legal problem solving, and oral and written communication.

Law 360. Law and Literature. This interdisciplinary seminar entails the in-depth study of selected literary works that provide insights and raise questions concerning important legal issues and the nature and purposes of law. Emphasizes developing critical reading, speaking and writing skills.

Law 361. Modern Application of the Law of Armed Conflict (LOAC). A detailed overview of the modern requirements and restrictions on military operations, with particular emphasis on combat operations between military forces. Analysis of the legal framework that guides an officer at the strategic and operational level. Special focus on the Geneva and Hague Conventions, along with more current agreements such as the Landmine treaty and Rome/International Criminal court treaty.

Law 421. Law for Commanders. More than just a continuation and expansion of Law 220, Law for Air Force Officers, this course focuses on using real-world scenarios to help students think like a commander who has respect for the rule of law, knows how to evaluate basic legal advice about a problem, and appropriately uses it to make good decisions for the Air Force. It examines command authority over Air Force personnel, the extent of that authority to accomplish the mission and instill good order and discipline, the effective use of disciplinary tools, and common command/legal concerns facing leaders. A hands-on, application class that allows students to practice problem-solving skills and to communicate solutions and rationale appropriately.

Law 440. Cyberlaw. Explores the multitude of legal issues affected by the use of computers and the Internet. Examines closely the evolution of criminal law in cyberspace, specifically problems associated with jurisdiction, rights of privacy, searches and seizures, and evidence. Also examines how cyberspace impacts the law of war, including what constitutes the use of force in cyberspace, and how this all influences traditional notions of sovereignty. Although some basic technical information is discussed, this course is designed for the non-technical student. Discussions center on emerging legal issues to stimulate the interest of technically-minded students. As future commanders, students must be prepared to handle computer-related legal issues, whether criminal, intellectual property or use of force. These emerging problems of the 21st century are also points of discussion.

Law 456. National Security Law. Examination of the domestic and international legal authority affecting U.S. national security matters and the command and control of the key instruments of national security, focusing on the U.S. military. Topics include: Presidential and congressional treaty and war powers under the Constitution; command and control of the military under the modern national security system; legal authority for the international use of force; intelligence and information security law; terrorism and unconventional warfare; and domestic uses of military and the Posse Comitatus Act.

Law 461. International Law. Study of the legal principles which govern relations among nations. Students study the historical development of international law and important principles which govern relations among nations today. Topics include: options for settlement of disputes; the law which affects military operations and the status of U.S. forces stationed overseas; roles and powers of international organizations; and the law of the sea.

Law 466. Advanced Topics in the Law of Armed Conflict (LOAC). Goes beyond the fundamental principles and primary sources of LOAC explored in Law 361. Focuses on unsettled questions and contemporary issues. Topics include the modern use of force, the definitions of combatants, the interplay of LOAC and human rights law, international criminal tribunals, rule of law efforts and other current issues. Students explore primary and secondary sources in a seminar setting, enhancing critical analysis and sharpening oral and written communication skills.

Law 485. Legal Studies Capstone. Uses multiple law-related scenarios based upon contemporary military, national and international issues. Affords students the opportunity to integrate knowledge and expertise acquired in other law courses and further hone their analytical and communication skills as they work together to identify and resolve complex legal issues.

Law 495. Special Topics. Selected topic or topics in law.

Law 499. Independent Study. Study and research in a legal topic or topics of choice for students who have demonstrated their ability for advanced study in regularly offered enrichment courses. Topics and meetings arranged with the instructor.

management major

The management major prepares students for management and leadership roles in today's technologically complex, global Air Force. The curriculum is designed to develop students who can understand, analyze and improve organizations through the efficient and effective use of systems. The courses in the major help develop adaptive capacity and the organizational knowledge and skills vital for Air Force officers as well as future national leaders. The management major is accredited by the Association to Advance Collegiate Schools of Business (AACSB) and ranks among the most prestigious undergraduate management and business degrees in the nation. The Academy's curriculum, together with our core courses, provides an excellent educational foundation for those interested in pursuing Air Force careers such as acquisition manager, air battle manager, aircraft maintenance, communications and information, contracting, cost analysis, financial management, health services administrator, intelligence, logistics readiness, navigator, pilot, security police, space and missile operations and special investigator. Additionally, the management major prepares students interested in pursuing graduate degrees in management, management science and/or business administration.

The management major is designed to produce critical thinkers who will lead organizations to quickly adapt and succeed in rapidly changing, highly technical, global environments. Management majors study traditional managerial and business topics such as organizational perspectives and theories, global organizations, complex human systems, financial and managerial accounting, managerial finance, human resource management, marketing, production and operations management, information systems and strategic management. Related subjects, such as personal finance and investing, are also popular among our majors.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Eng 315	Academy Opt
Econ 201	Beh Sci 310	Astro Engr 410
ECE 315	Biology 315	English 411
English 211	History 302	Mgt Opt
Engr Mech 220	Math 300	Mgt 423
For Lang 3	Mgt 303	Mgt 437
For Lang 4	Mgt 341	Mgt 472
Law 220	Mgt 342	Mgt Capstone Enrichment
MSS 200	Mgt 345	Mgt Capstone Prep
Ops Rsch 310	Mgt 361	Mgt Opt (1st Class)
Physics 215	Mgt Opt (2nd Class)	MSS 400
Pol Sci 211	Philos 310	Soc Sci 412

MANAGEMENT (Mgt)
Offered by the Department of Management (DFM).

Mgt 303. Management Perspectives. Introduces students to the complex and dynamic nature of the world in which Air Force officers and managers operate. They are introduced to various perspectives that provide multiple insights into how the world functions.

Mgt 341. Financial Accounting. Analysis of business transactions and recording of business data taught from the perspective of understanding the theoretical and practical issues in measurement of income, assets, liabilities and owner's equity. Annual reports are used to perform financial statement analysis. Alternative accounting methodologies permitted under GAAP are explored.

Mgt 342. Managerial Accounting. Focuses on the uses of accounting information by managers. Discusses full cost accounting and responsibility accounting, from the perspective of data collection and analysis, for short and long range decisions. Topics include cost behavior, activity-based costing, contribution margin analysis, measurement of cost of goods manufactured, capital budgeting and management control systems.

Mgt 345. Human Managerial Systems I. Introduction to individual and group theories of behavior and their integration into the organization as a whole. Theories of attitude, behavior and cognition are applied to the understanding of how to make decisions based on accurate diagnoses of situations that involve people in organizational systems. Organizational behavior

issues like motivation, organizational citizenship behavior, organizational justice, decision making, conflict/negotiation, productivity, organizational learning, participative management, and power and politics will be applied to human capital issues such as human resource planning, job design/analysis, performance appraisal, pay-for-performance, training and career development, and legal issues in the work place. Topics apply to both the public and private sectors. Students learn through a variety of experiential exercises and case studies.

Mgt 361. Human Managerial Systems II. A continuation of Mgt 345 with greater depth and more emphasis on case studies and practical application of course concepts.

Mgt 372. Introduction to Investments. Introduces financial markets, investment vehicles (stocks, bonds, mutual funds and derivatives) and retirement planning. Specific topics include time value of money, risk and return, valuation, portfolio mathematics, behavioral finance and the basics of mutual funds. Additionally, officer-relevant personal finance discussions enrich the core material. This course is introductory in nature and assumes no knowledge of accounting or financial markets. A term project provides experience in comprehensive portfolio management—developing and analyzing investment opportunities for a young officer's portfolio. Designed for non-management and non-systems engineering management majors.

Mgt 375. Market Analysis. Emphasizes how marketing concepts can be used to analyze different markets to both determine customer needs and to deliver customer value. Analyzes both product and service markets with special emphasis on government and public sector concerns. Covers market research, segmentation, distribution, supply chain, cost and pricing considerations. Additionally, this course provides students certain market analysis tools they will find useful in Mgt 419, Technological Innovation Management.

Mgt 382. Investments. Introduces financial markets, investment vehicles (stocks, bonds, mutual funds and derivatives) and retirement planning. Specific topics include time value of money, risk and return, valuation, portfolio mathematics, behavioral finance and the basics of mutual funds. Additionally, officer-relevant personal finance discussions enrich the core material. Assumes a prior knowledge of the principles developed in financial accounting. This course may be completed before, after or concurrently with managerial finance. A term project provides experience in comprehensive portfolio management—developing and analyzing investment opportunities for a young officer's portfolio.

Mgt 391. Information Technology for Organizations. Examines how organizations use information technology to support the four major management functions of planning, organizing, leading and controlling. Topics include information systems management, telecommunications, hardware trends, data warehousing and information security in cyberspace. Students develop proficiency with current database and spreadsheet applications. Application of contemporary theory to both critical issues in the public and private sectors is stressed through seminars, case studies, field trips and projects.

Mgt 392. Organizational Networks in Cyberspace. Examines how organizations use information technology to develop and manage relationships with external institutions. Topics covered include electronic commerce, supply chain management, customer relationship management, e-government and electronic networking in cyberspace. Emphasis is on legal, cultural and international issues. Case studies offer a real-world emphasis. Organizational strategies are analyzed, using examples of both successful and unsuccessful online implementations. Students get hands-on Web site development experience.

Mgt 400. Management and Command. Introduces students to the complex and dynamic nature of the world in which Air Force officers operate. Through content linked to systems theory, this interactive course focuses on the successful techniques that allow officers to understand and influence their environment. Using various models and processes, students explore the interrelationships of power and the context within which it occurs. Students gain insights into how to make decisions for situations that involve complexity and uncertainty. Tools are applied to both military and non-military scenarios, with emphasis on the transition from the cadet role to the role of an officer.

Mgt 405. Management Seminar. Seminar for first-class management majors providing the opportunity for the presentation of student and faculty research, guest lectures, seminars on career and graduate school opportunities for management majors in the Air Force, goal setting exercises and applications of management principles.

Mgt 419. Technological Innovation Management. Examines how to recognize, analyze and exploit opportunities in the competitive environments faced by business, nonprofit and government organizations. Students explore the resources, processes and structures necessary to transfer technological innovations to appropriate markets. Application of innovation management theories is stressed through the use of case studies, analysis papers, field trips and projects. By the end of the course, students will have completed a feasibility study of a new concept which can be further developed in capstone projects.

Mgt 420. Systems Research and Development Management. Students complete an original, applied systems research and/or development project that demonstrates their capacity to solve complex problems in an organizational setting. Each student chooses a project from among three options: 1) Management Field Studies: Teams or individuals complete advanced case studies or organizational consulting projects for clients developed through the Management Department or arranged by the team independently with departmental approval–students work closely with clients and faculty to define and analyze difficult managerial and competitive problems and make recommendations for future action by the client or subject organization; 2) Venturing Projects: Teams or individuals develop or select innovative projects and create new venture plans or feasibility studies; or 3) Research Projects: Teams or individuals propose and investigate significant managerial or technological issues in a research context. These projects require extensive interaction with faculty to develop research findings that can be presented and/or published.

Mgt 423. Managerial Economics. Traditional economic theory emphasizing the principles of product and factor pricing, allocation and employment of resources, and the implications of various market structures. In addition to these microeconomic topics, the use of other economic tools which may aid the decision maker will be discussed including topics in macroeconomics and international economics. (Administered by the Department of Economics and Geosciences.)

Mgt 437. Managerial Finance. Study of financial decisions and their effects on the value of the firm. Emphasizes developing the concept of risk/return tradeoff. Topics include stock and bond valuation, capital budgeting, cost of capital, dividend policy and capital structure. Case studies and problems expose the student to current financial problems and their solutions.

Mgt 440. Management Lessons in Literature. Through a collection of classic and contemporary stories, novels and plays, this course provides a unique perspective of organizational life. It looks at what authors like Arthur Miller and Mark Twain can tell you about being a more effective manager. Great literature reflects familiar patterns of behavior in a variety of circumstances. But, unlike self-help, inspirational and how-to manuals, they dispense no advice; they preach no morals; they prescribe no rules. In a world of turbulent change, the works of literature offer us vivid testimony as to what stays constant in human behavior.

Mgt 446. Organizational Theory. Course examines the practical theories managers apply to create value in an organization. Given that managers must design the structure and culture of their organizations, students study and apply a number of contemporary and practical theories for effectively diagnosing organizational situations and designing activities that will create successful firms. Learning methods emphasize case studies, field trips and analytical projects.

Mgt 448. Power and Influence in Organizations. Focuses on understanding how managers can effectively mobilize resources to be effective in their job. Course examines how power is acquired, retained and used in organizations. In addition, what effect power has on employees and the overall performance of the organization is explored. Students learn through a variety of experiential exercises and case studies.

Mgt 472. Strategic Management Capstone. Emphasizes integration of organizational strategy formulation and implementation to include such topics as the strategic management process, environmental forecasting and analysis, strategic planning, top-level decision making, the strategic use of technology, the management of innovation and strategic control. Application of contemporary theory to both critical issues in the public and private sectors is stressed through the use of seminars, case studies, field trips, distinguished guest speakers and projects.

Mgt 477. Production and Operations Management. In-depth examination of the issues, strategies and analytic techniques involved in providing resources to accomplish Air Force missions. The dominant theme is providing quality products on time and at a minimal cost. Discussions center on qualitative and quantitative approaches for managing production, logistics and service organizations to create higher quality and greater efficiency.

Mgt 495. Special Topics. Selected topics in management.

Mgt 498. International Management. As a result of the increase in communications and flow of information, there is a growing need to possess a greater understanding about global, cross-cultural management issues. This course examines management on an international level looking at cultural, legal, financial and trade considerations for managing in the Global Century, while integrating the functional areas of management.

Mgt 499. Independent Study. Tutorial investigation of a specific area of management.

mathematical sciences major

We've designed the mathematical sciences major to teach the problem solving, analytical and communication skills needed to deal with the complex operational, management, engineering and mathematical problems encountered as officers in the Air Force of today and tomorrow. Students take courses in applied mathematics, analysis, statistics and operations research to provide a breadth of education beyond the classical areas of mathematical study. In each of these areas students increase their ability to: a) logically analyze a problem; b) determine the tools required to formulate a solution; c) develop and execute the solution and d) effectively communicate the process and conclusions of that solution. The key to the Mathematics major is flexibility. It allows the flexibility to choose the areas of study. Students have an opportunity to choose one of three specialty options allowing the study of the area of mathematics in which they're most interested. Should students declare a second major, they can substitute courses from their second discipline for open options. The program also provides enormous flexibility in the opportunities that will be available as an Air Force officer. An officer with a background in mathematics has many different Air Force Specialty Codes (AFSC) from which to choose, such as space systems analyst, scientific analyst and intelligence applications officer. This list is certainly not exhaustive since it doesn't include any of the Air Force specialties with no specific degree requirements. Mathematics majors do very well in a diverse set of graduate school disciplines, such as business administration, computer science, economics, most engineering disciplines, law, medicine, meteorology, operations research, physics and of course mathematics.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt
Comp Sci 211	Beh Sci 310	Astro Engr 410
Econ 201	Biology 315	English 411
English 211	ECE 315	Math 342
Engr Mech 220	History 302	Math 420
Law 220	Math 346	Math 421
Math 243	Math 360	Math Open Opt
Math 245	Math 366	Math Opt 1
Math 320	Math 377	Math Opt 2
MSS 200	Math 378	Mgt 400
Physics 215	Philos 310	MSS 400
Pol Sci 211	Sys Opt/Ops Rsch 310	Soc Sci 412

MATHEMATICS (Math)
Offered by the Department of Mathematical Sciences (DFMS).

Math 130. Basic Math-Algebra and Trigonometry. Designed to help reinforce algebraic and trigonometric skills necessary for success in the technical core. Basic graphing, algebraic manipulation and trigonometric calculations are covered. Elementary functions, function manipulation and some function applications are also discussed. May be used as an Academy option to fulfill graduation requirements. Does not fulfill any major's requirements.

Math 141. Calculus I. Study of differential calculus. Topics include functions and their applications to physical systems; limits and continuity; a formal treatment of derivatives; numeric estimation of derivatives at a point; basic differentiation formulas for elementary functions; product, quotient and chain rules; implicit differentiation; and mathematical and physical applications of the derivative, to include extrema, concavity and optimization. Significant emphasis is placed on using technology to solve and investigate mathematical problems.

Math 142. Calculus II. Study of integral calculus with a focus on the Fundamental Theorems and their application. Topics include estimating area under a curve; accumulation and total change, basic numeric integration methods; antiderivative formulas for the elementary functions; integration by substitution and parts; improper integrals; differential equations; exponential growth and decay; an introduction to Taylor Series; and mathematical and physical applications of the Fundamental Theorems. Physical applications include area and volume problems and the concept of work.

Math 152. Advanced Placed Calculus II. Integral calculus for advanced-placed fourth-class cadets. Content is similar to Math 142, but with more in-depth treatment.

Math 243. Calculus III. Multivariate calculus, including lines, planes and surfaces in 3-space; vector functions, partial differentiation and directional derivatives; maxima and minima in multiple dimensions and the method of Lagrange Multipliers; multiple integration and line integrals culminating in Green's Theorem. Designed for students indicating an interest in a technical major.

Math 245. Differential Equations. Modeling with and analysis of linear ordinary differential equations. Includes matrix algebra and matrix inverses, first-order ordinary differential equations (numerical methods, separation of variables, integrating factors and method of undetermined coefficients), and second-order linear differential equations/first-order linear systems (Laplace transforms, determinants, eigenvalues, eigenvectors and stability). Applications may include population growth, predator/prey and mass-spring system modeling.

Math 253. Advanced Placed Calculus III. A more intense study of multivariate calculus for advanced-placed freshman students. Content is similar to Math 243. Additional emphasis is placed on mathematical and physical applications in preparation for students interested in pursuing a technical major.

Math 300. Introduction to Statistics. Descriptive statistics emphasizing graphical displays; basic probability and probability distributions; sampling distribution of the mean and the Central Limit Theorem; statistical inference including confidence intervals and hypothesis testing correlation; and regression. Designed primarily for social sciences and humanities majors. Emphasizes elements of statistical thinking, focuses on concepts, automates most computations, and has less mathematical rigor than Math 356.

Math 310. Mathematical Modeling. Introductory course in mathematical modeling. Students model various aspects of real-world situations chosen from Air Force applications and from across academic disciplines, including military sciences, operations research, economics, management and life sciences. Topics include: the modeling process, graphical models, proportionality, model fitting, optimization and dynamical systems. Several class periods are devoted to in-class work on small projects. Not appropriate for math or operations research majors.

Math 320. Foundations of Mathematics. Emphasizes exploration, conjecture, methods of proof, ability to read, write, speak and think in mathematical terms. Includes an introduction to the theory of sets, relations and functions. Topics from algebra, analysis or discrete mathematics may be introduced.

Math 340. Discrete Mathematics. Useful for students interested in applications of mathematics to computer science and electrical engineering. Propositions and logic; sets and operations on sets; functions, recursion and induction; graphs, trees and their applications; discrete counting and combinatorics.

Math 342. Numerical Analysis. Introductory numerical analysis course. Specific topics include round off, truncation and propagated error; root finding; fixed-point iteration; interpolating polynomials, and numerical differentiation and integration. The approach is a balance between the theoretical and applied perspectives; laboratories emphasize programming methods and applying a computer algebra system to theoretically analyze methods.

Math 344. Matrices and Differential Equations. Properties, types and operations of matrices; solutions of linear systems; Euclidean vector spaces, linear independence and bases; eigenvalues and eigenvectors. Computational aspects. Applications to differential equations. First- and second-order differential equations and systems. Models may include population growth, warfare and economics.

Math 346. Engineering Math. Provides advanced mathematical concepts and skills necessary for technical disciplines. Topics include differential and integral vector calculus (surface integrals, flux, Divergence Theorem, Stokes' Theorem), Fourier series, orthogonal functions and partial differential equations (separation of variables, transform methods).

Math 356. Probability and Statistics for Engineers and Scientists. Classical discrete and continuous probability distributions; generalized univariate and bivariate distributions with associated joint, conditional and marginal distributions; expectations of random variables; Central Limit Theorem with applications in confidence intervals and hypothesis testing; regression and analysis of variance. Designed for students in engineering, science or other technical disciplines. A core substitute for Math 300.

Math 359. Design and Analysis of Experiments. Introduction to the philosophy of experimentation and the study of statistical designs. Course requires a knowledge of statistics at the Math 300 level. Topics include design and analysis of single-factor and many-factor studies. A valuable course for all science and engineering majors.

Math 360. Linear Algebra. A first course in linear algebra focusing on Euclidean vector spaces and their bases. Using matrices to represent linear transformations and to solve systems of equations is a central theme. Emphasizes theoretical foundation (computational aspects are covered in Math 344).

Math 366. Real Analysis I. Theoretical study of functions of one variable focused on proving results related to concepts first introduced in differential and integral calculus. An essential prerequisite for graduate work in mathematical analysis, differential equations, optimization and numerical analysis.

Math 370. Introduction to Point-Set Topology. Review of set theory; topology on the real line and on the real plane; metric spaces; abstract topological spaces with emphasis on bases; connectedness and compactness. Other topics such as quotient spaces and the separation axioms may be included. A valuable course for all math majors in the graduate school option.

Math 372. Introduction to Number Theory. Basic facts about integers, the Euclidean algorithm, prime numbers, congruencies and modular arithmetic, perfect numbers and the Legendre symbol will be covered and used as tools for the proof of quadratic reciprocity. Special topics such as public key cryptography and the Riemann Zeta function will be covered as time allows.

Math 374. Combinatorics and Graph Theory. Permutations, combinations, recurrence relations, inclusion-exclusion, connectedness in graphs, colorings and planarity. Theory and proofs, as well as applications to areas such as logistics, transportation, scheduling, communication, biology, circuit design and theoretical computer science.

Math 377. Advanced Probability. Topics include probability fundamentals, discrete and continuous random variables, single and multivariate probability distributions, functions of random variables, sampling distributions and the Central Limit Theorem. This course is designed for mathematics and operations research majors.

Math 378. Advanced Statistics. Topics include point and interval estimation, properties of point estimators, sample inferential statistics with confidence intervals, hypothesis testing, ANOVA, linear regression, design and analysis of experiments and nonparametric statics. A core substitute for Math 300 but with more rigor and depth.

Math 420. Mathematics Capstone I. The first semester of the mathematics capstone experience. Students decide on a topic of independent research in, or related to, the mathematical sciences and begin work with a faculty advisor. Significant progress toward a thesis will be made during the semester.

Math 421. Mathematics Capstone II. The second semester of the mathematics capstone experience. Students complete work on their independent research project and produce a thesis to present their findings.

Math 443. Numerical Analysis of Differential Equations. Intermediate numerical analysis course with an emphasis on solving differential equations. Specific topics include solving linear and nonlinear systems; solutions of initial value problems via Runge-Kutta, Taylor and multistep methods; convergence and stability; and solutions of boundary value problems. Other topics include approximating eigenvalues and eigenvectors and numerically solving partial differential equations. Balanced between the theoretical and applied perspectives with some computer programming required.

Math 451. Complex Variables. Valuable course for students intending to pursue graduate work in mathematics or its applications, particularly in areas involving partial differential equations. Analytic functions; integration, the Cauchy Integral Theorem and applications; power and Laurent series, residues and poles; conformal mapping with applications to potential theory and fluid flows.

Math 465. Modern Algebra. Valuable course for students intending to pursue graduate work in mathematics or its applications. Focuses on the study of algebraic structures and functions between these structures. Topics include: cyclic groups, permutation groups, normal subgroups and quotient groups; rings, ideals, polynomial rings and fields. Depending on instructor and student preferences, applications to coding theory, crystallography or combinatorics are explored.

Math 467. Real Analysis II. Theoretical study of functions of several variables to include topology of Cartesian spaces, compact and connected sets, convergence of sequences of functions, continuous functions, fixed point theorems, contractions, Stone-Weierstrass approximation theorems, differentiation, partial differentiation, mapping theorems and Implicit Function Theorem.

Math 468. Dynamical Systems. The study and application of linear and nonlinear differential equations to physical systems from both computational and analytical points of view. Topics vary but may include these typical choices; systems of differential equations, stability analysis, bifurcations, maps and chaos.

Math 469. Partial Differential Equations. Solutions of boundary value problems with applications to heat flow, wave motion and potential theory. Methods of solution include separation of variables and eigenfunction expansion, including Fourier series. Topics typically include the method of characteristics, generalizations to higher dimensions and the use of non-Cartesian coordinate systems. Additional topics may include numerical methods, nonlinear equations and transform methods.

Math 470. Mathematical Physics. Introduction to various mathematical topics needed in graduate-level physics and applied mathematics courses, including special functions (Legendre, polynomials, Bessel functions, etc.), calculus of variations and series solutions of ordinary differential equations. Additional topics may include integral transform concepts (Fourier and Laplace transforms, Green's functions), linear algebra (function spaces, tensors) and complex functions (Laurent series, contour integration and the Residue Theorem).

Math 495. Special Topics. Selected advanced topics in mathematics.

Math 499. Independent Study and Research. Individual study and/or research under the direction of a faculty member.

mechanical engineering major

Students wanting to design and build things should consider majoring in mechanical engineering. Mechanical engineering is, more than anything else, the engineering of systems. Systems are interactions of components, power and information. Examples include an automobile's fuel injected, electronic ignition power train; it's electronically controlled and load leveling suspension system; its anti-lock, traction control braking system; or its climate control system. Aircraft systems include turbine engines, attitude and flight controls, automated navigation and guided weapons. There are incredible mechanical engineering systems in space hardware, power generation facilities and manufacturing. Because systems bring together the engineering of mechanics and motion, thermodynamics and fluids, materials and structures and control, mechanical engineering is a broad discipline of design and analysis. The mechanical engineering degree is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 - telephone: (410) 347-7700.

The goal of the mechanical engineering program is to prepare students to become leaders of character who:

- Possess breadth of integrated, fundamental knowledge in engineering, the basic sciences, social sciences and the humanities; and depth of knowledge in mechanical engineering.
- Communicate effectively.
- Work effectively on teams and grow into team leaders.
- Are independent learners, and as applicable, are successful in graduate school.
- Can apply their knowledge and skills to solve Air Force engineering problems, both well- and ill defined.
- Know and practice their ethical, professional and community responsibilities as embodied in the Air Force core values.

Upon completion of the mechanical engineering program each graduate shall demonstrate satisfactory:

- Application of the fundamental analysis concepts of mechanical engineering to solve engineering problems.
- Modeling, design and fabrication techniques of thermal and mechanical systems under real-world conditions.
- Use of contemporary mechanical engineering analysis, design and test tools.
- Experimental techniques to include test design, execution, data analysis and interpretation.
- Written and oral communications skills.
- Knowledge of ethical and professional responsibilities.
- Breadth and depth of engineering knowledge and skills to effectively identify and solve the types of complex, interdisciplinary problems they will encounter as Air Force engineers.
- Ability to be effective interdisciplinary team members and leaders.
- Skills to be independent life-long learners while knowing when to seek help.
- Knowledge of contemporary social, political, military and engineering issues, as well as the role of Air Force engineering officers and citizens in our global society.

With a degree in mechanical engineering students can get an Air Force assignment as an aeronautical engineer, astronautical engineer, civil engineer, mechanical engineer or project engineer. The mechanical engineering degree also satisfies the educational requirements for Air Force test pilot, flight test navigator and flight test engineer duties. Additional specialties are scientific analyst and acquisition project officer. Successful completion of this degree may qualify you for assignment in the developmental mechanical engineer career field.

If you are a top performer in the mechanical engineering major, graduate school can be an option as a first Air Force assignment, either by winning a prestigious national scholarship (Guggenheim, Hertz, Rhodes, etc.) or through direct departmental sponsorship. The mechanical engineering major gives you the flexibility to pursue either a more specialized degree in graduate school or to continue your broad-based study in engineering. Whether you ultimately choose a graduate program in aeronautical engineering, astronautical engineering, materials engineering or mechanical engineering, your decision will be an informed one.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt/Mech Engr Opt 2
Econ 201	Beh Sci 310	Astro Engr 410
ECE 231	Biology 315	English 411
English 211	Engr Mech 305	Engr Mech 460
Engr Mech 220	Engr Mech 320	Mech Engr 325
Engr Mech 330	Engr Mech 350	Mech Engr 441
Law 220	History 302	Mech Engr 491
Math 243	Math 346	Mech Engr 492
Math 245	Math 356	Mech Engr Analysis Opt
MSS 200	Mech Engr 341	Mech Engr Opt 1
Physics 215	Mech Engr 370	MSS 400
Pol Sci 211	Philos 310	Soc Sci 412
	Sys Opt Mech Engr 312	

MECHANICAL ENGINEERING (Mech Engr)
Offered by the Department of Mechanical Engineering (DFEM).

Mech Engr 312. Thermal Fluids Systems Engineering I. First and second laws of thermodynamics applied to closed systems; basic modes of heat and work processes, with concentration on conduction. Mass and momentum conservation, entropy balance. Cycle concepts as applied to Carnot cycle. Properties of thermodynamic substances, including phase diagrams, ideal gases and pure substances. Fundamental aspects of fluid statics. Bernoulli and mechanical energy equations. Laboratory methods and applications. Emphasizes developing problem solving methods applied to thermal-fluids systems and on communication skills.

Mech Engr 325. Engineering System Dynamics. Modeling, analysis and design of multi-domain engineering systems including mechanical, electrical, hydraulic, instrumentation and control elements. Models are developed based on tracking power interactions between system components. Mathematical models are developed in state space form and are investigated both analytically and numerically. System response to initial conditions and forcing functions is examined. Tools are introduced to predict system stability, behavior and response to parameter variation. Non-linear models and elementary control systems are introduced.

Mech Engr 341. Thermal Fluids Systems Engineering II. Continuation of Mech Engr 312. First and second laws of thermodynamics applied to open systems. Basic engineering plant component analysis, to include isentropic efficiencies. Navier-Stokes equations and applications. Fluid flow and heat transfer boundary layer applications. Convection heat transfer, with a concentration on heat exchangers. Dimensional analysis, modeling and similitude. Laboratory methods and applications. Emphasis on developing problem solving methods applied to thermal-fluids systems and on communications skills.

Mech Engr 370. Introduction to Machine Design. Introduction to static failure theories and fatigue. Analysis and design of machine components including shafts, hydrodynamic and rolling element bearings, spur gears, clutches, brakes and springs. Design of joints using screws, bolts and welds. Emphasizes stress analysis and design trade-offs.

Mech Engr 396. Mechatronics. Integration of mechanical and electrical design, applying the design process to develop an integrated electromechanical system autonomously controlled by a microprocessor. Electrical system development topics include digital logic, actuator control, sensor integration and signal conditioning. Group design projects throughout the semester leading to the integrated final project. Open only to mechanical engineering majors with departmental permission.

Mech Engr 441. Thermal Fluids Systems Engineering III. Radiation heat transfer. Numerical methods applied to selected problems in heat transfer and fluid mechanics. Introduction to basic power cycles (Rankine, Otto, Diesel, Brayton, etc.). Psychometric processes. 1-D compressible flow with application to turbomachinery and varying area channels, to include normal shocks. Analysis of turbomachinery. Laboratory methods and applications. Emphasizes on developing problem solving methods applied to thermal fluids systems and on communications skills.

Mech Engr 467. Energy Conversion. Applications of the first and second laws of thermodynamics to the major energy converters including steam plants, internal combustion engines and turbojet engines. Additional topics may include combustion analysis, energy storage, refrigeration and alternate energy sources.

Mech Engr 490. Automotive Systems Analysis for the Engineer. Analysis of the modern automobile as an engineering system. Engineering concepts applied to the design, maintenance and integration of automotive subsystems. Analysis of power plants, clutches, transmissions, drive trains, suspension systems, steering and braking dynamics, and overall vehicle performance including economy.

The following appear in the core majors as well as in various other majors. However, they are not listed under the course descriptions for any particular major. They are provided here for convenience.

Engr Mech 220. Fundamentals of Mechanics. Introduces the fundamental principles of statics and mechanics of materials applied to aerospace systems. Topics include: force and moment equilibrium using free body diagrams and vector algebra; stress, strain and deformation response of deformable bodies to axial, torsional, flexural and combined loadings; material properties and selection criteria; and failure modes of materials and structures.

Engr Mech 305. Engineering Tools Seminar. A junior-level seminar course designed to help mechanical engineering majors transition into the degree-granting program. Includes essential skills required for success in the mechanical engineering program. Emphasizes safe operation of critical lab equipment and hands-on engineering tools with in-class practice using related hardware, software and program-specific techniques.

Engr Mech 320. Dynamics. Covers the analysis of kinematic and kinetic motions of particles and rigid bodies and introduces mechanical vibrations of simple systems. Topics include kinematics with absolute and relative motions in Cartesian, path and polar coordinates; kinetics using force-mass-acceleration, work-energy and impulse-momentum methods; and vibration equation-of-motion generation and analysis. Emphasizes vector solutions.

Engr Mech 330. Mechanics of Deformable Bodies. Axial loading. Statically indeterminate structures. Beam theory: shear and moment diagrams, stress and deflection. Transformation of stress and strain. Mohr's circle. Introduces failure theories and classical lamination theory. Euler buckling. Stress concentrations. Introduces energy methods and Castigliano's theorems.

Engr Mech 340. Materials Science for Engineers. Surveys engineering applications of non-ferrous and ferrous alloys, polymers, ceramics and composites. Basic crystallographic notation and molecular structure of common engineering materials. Principles of metallurgical thermodynamics and kinetics applied to phase transformations and strengthening mechanisms.

Engr Mech 350. Mechanical Behavior of Materials. Behavior of materials under simple axial, biaxial and triaxial states of stress. Micromechanisms of elastic and inelastic deformation and strengthening mechanisms. Introduces linear elastic fracture mechanics. Fatigue failure theories and fatigue crack growth analysis. Applications to design of aerospace vehicles and structures.

Engr Mech 440. Physical Metallurgy. Physical metallurgy related to properties of engineering metals. Studies crystal structure and imperfections, diffusion, thermodynamics, phases and phase transformations, and material processing and how each alters material properties. Discusses specific metals/alloy systems and design philosophies for new alloys. Thermomechanical strengthening design project and semester-long knife design and construction project.

Engr Mech 460. Experimental Mechanics. Introduces experimental measurements and their role in the mechanical design process. Includes theory and application of static and dynamic instrumentation to include: strain, vibration, temperature, and pressure transducers. Hands-on laboratory experience constitutes one-half of the course. Laboratory sessions involve analysis, design, test plans, calibration and testing.

Mech Engr 491. Capstone Design Project I. Capstone engineering design experience for mechanical engineering majors. Emphasizes the design process, complete analysis and technical communication in the creative development of a mechanical system. The system is designed, fabricated and tested against performance specifications determined by faculty members.

Mech Engr 492. Capstone Design Project II. Capstone engineering design experience for mechanical engineering majors. Emphasizes the design process, complete analysis and technical communications in the creative development of a mechanical system. The system is designed, fabricated and tested against performance specifications determined by faculty members.

Mech Engr 499. Independent Study. Individual study, research or design on a topic established with approval of the department head.

meteorology major

Meteorology is the study of atmospheric phenomena. The meteorology major provides the background necessary for understanding atmospheric behavior over a broad range of time and space scales. These include small features such as turbulent eddies and tornadoes; medium-sized features such as squall lines, hurricanes and blizzards; and even larger features such as continental weather, climate regimes and waves in the jet stream.

The science of meteorology has experienced dramatic changes. New observation techniques based on remote sensing have improved our understanding of weather phenomena and their interrelationships. Images of the earth from satellites have given us a truly global weather perspective. Doppler radar enables us to look at the circulations within thunderstorms to try to identify whether they might generate a tornado. Coupled with this increased observational capability, the introduction of sophisticated numerical weather prediction models has greatly improved our ability to forecast the weather.

The meteorology major requires a strong foundation in physics, geospatial science and mathematics, in addition to an aptitude for problem solving. Many of the decisions Air Force officers make, from planning deployments and air strikes in a time of war to launching the Space Shuttle, flying a sortie, or simply deciding what uniform to wear on a particular day, are affected by the weather. While graduates in the meteorology major are academically qualified to enter the weather career field, future pilots and navigators can greatly benefit from a better understanding of the environment in which they fly.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Biology 315	Aero Engr 315	Academy Opt
Chem 200	Beh Sci 310	Astro Engr 410
Econ 201	ECE 315	English 411
English 211	History 302	Meteor 431
Engr Mech 220	Math 300/356/378	Meteor 440
Law 220	Meteor 325	Meteor 451
Math 243	Meteor 330	Meteor 452
Math 245	Meteor 352	Meteor 465
Meteor 320	Meteor 430	Meteor 490
MSS 200	Philos 310	Mgt 400
Physics 215	Physics 370	MSS 400
Pol Sci 211	Sys Opt Geo 310	Soc Sci 412

METEOROLOGY (Meteor)
Offered by the Departments of Economics and Geosciences (DFEG) and Physics (DFP).

Meteor 320. Introduction to Meteorology and Aviation Weather. Surveys the fundamentals of meteorology. Emphasizes flight weather and its impact on aviation. Topics include atmospheric thermodynamics, cloud physics, air masses and weather systems, weather forecasting, severe weather, hazards to aviation, introduction to weather satellites and radar and an introduction to the near-earth space environment.

Meteor 325. Weather Data, Analysis and Quantitative Methods. Introduction to the data sources, objective and subjective data analysis techniques, and quantitative methods used in meteorology. Topics include conventional surface and upper air data, fundamentals of radar and satellite observations, weather map analysis, and quantitative methods covering partial derivatives, vector analysis, kinematic properties of fluid flow, Lagrangian and Eulerian frames of reference, and numerical integration and differentiation. Emphasizes practical application of the above quantitative techniques to weather charts and vertical atmospheric soundings.

Meteor 330. Physical Meteorology. Classical radiative transfer, thermodynamics and microphysics applied to the atmosphere. Topics include atmospheric absorption and attenuation, the gas laws, the first and second laws of thermodynamics, water-air systems, isobaric, adiabatic and isentropic processes, thermodynamic diagrams, atmospheric statics and vertical stability, atmospheric aerosols, nucleation of water vapor and ice, cloud droplet and ice crystal growth and precipitation generation.

Meteor 352. Climatology. Introduction to climatology, including fundamental, long-term processes involving energy, moisture and momentum transfer in the earth's climate system. Topics include understanding current world climate patterns and climate change and applying climatology to enhance human activities.

Meteor 430. Atmospheric Dynamics I. Advanced course in atmospheric dynamics. Topics include continuity, thermodynamic energy, the equations of motion, hydrostatic balance, generalized vertical coordinate systems, balanced and unbalanced flows, circulation, vorticity and potential vorticity and quasi-geostrophic theory.

Meteor 431. Atmospheric Dynamics II. Advanced applications of atmospheric dynamics. Topics include advanced quasi-geostrophic applications, baroclinic instability, cyclogenesis, fronts and frontogenesis, atmospheric wave theory and behavior, boundary layer physics and numerical weather prediction.

Meteor 440. Synoptic-Dynamic Meteorology Laboratory. Laboratory course emphasizing the use of meteorological observations, analyses and forecasts to describe the structure and dynamics of large-scale atmospheric systems. Involves extensive use of conventional surface and upper-air observations, satellite and Doppler radar data and numerical forecast products in the meteorology laboratory.

Meteor 451. Synoptic Meteorology. Study of the development and evolution of large-scale weather systems, including surface and upper level pressure, temperature and wind patterns, air masses, fronts, extratropical cyclones and jet streams.

Meteor 452. Mesoscale Meteorology. Study of the structure, development and evolution of mesoscale weather systems. Topics include fronts and jet streams, instabilities, gravity waves, convective storms, squall lines, tornadoes and mesoscale convective complexes. Introduces analysis techniques and nowcasting. Extensive use of real-time satellite and Doppler radar data and numerical forecast products in the meteorological laboratory.

Meteor 465. Marine and Tropical Meteorology. Introduction to the marine environment including the structure of the ocean environment, visibility at sea, and sea-state and swell forecasting, and to the tropical environment including understanding the interactions between the tropics and mid-latitudes, tropical cyclone structure and tropical cyclone forecasting. Emphasizing how these environments affect joint Naval and Air Force operations.

Meteor 490. Meteorological Interpretation, Analysis and Integration. Capstone course in meteorology. Using real world scenarios, course assesses the student's ability to integrate and synthesize a wide range of meteorological information to include observational data, analyses and operational forecasts. Particular attention is given to weather support for military operations.

Meteor 499. Independent Study. Individual research under the direction of a faculty member.

military strategic studies major

Effectiveness as an Air Force leader will be shaped by the ability to think strategically and creatively when faced with the complex operational challenges of the 21st century security environment. The military strategic studies (MSS) major prepares one to lead and operate across the spectrum of conflict. Whether students choose to make the Air Force a career, pursue other public service or enter the private sector, this versatile major has direct relevance for their chosen profession and helps develop the capabilities and mindset to compete successfully in a changing and challenging world.

The MSS major sharpens and expands upon the knowledge gained in the first MSS core course on military theory and strategy. Building upon that foundation, students pursue courses related to the uniquely demanding context of the military profession–morality and war, contemporary military threats, formulation of military strategy, theory of military transformation and the nature of contemporary air forces. Students learn to think as strategists, identifying and framing the battle space, evaluating theories and models applicable to air, information and space power. They also learn to plan and think as operators with multiple opportunities to simulate exploitation of the air, space and cyberspace operating environments with effects-based strategies, modern weapons technologies and unconventional approaches.

During the junior year, students acquire a solid understanding of air, space and information power theory and select a research topic in our research methods course. With the help of an advisor, they design what will become their senior thesis. As seniors, students author their senior thesis and have an opportunity to publish their findings in our Airman-Scholar Journal. Students also take the advanced version of the final MSS core course on joint and coalition operations.

In addition to three required major's courses, students have the flexibility to choose among contemporary strategic functional domain and regional courses. Whichever course of study they plan, the MSS major will strengthen problem solving and decision making skills to directly prepare them to excel in the Air Force mission and beyond.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1stClass Year
Academy Opt	Aero Engr 315	Astro Engr 410
Chem 200	Beh Sci 310	Comp Reg Strategy 2
Econ 201	Biology 315	Comp Reg Strategy 3
English 211	Comp Reg Strategy I	English 411
Engr Mech 220	ECE 315	Mgt 400
For Lang 3	History 302	MSS 410
For Lang 4	Math 300	MSS 498
Law 220	MSS 379	MSS Elective
MSS 200	Functional Domain 1	Functional Domain 2
Physics 215	Philos 310	Functional Domain 3
Pol Sci 211	Philos 311	Strategic Context 2
Strategic Context 1	Sys Opt Geo 310	Soc Sci 412

MILITARY STRATEGIC STUDIES (MSS)
Offered by the Department of Military Strategic Studies (DFMI).

MSS 200. Military Theory and Strategy. Provides the professional cornerstone for the military officer through the exploration of military theories and strategies. Drawing on a wide range of military thought–from the ideas of the classical military thinkers to the propositions of modern theorists–students analyze relevant theories of warfare, evaluate various approaches to military strategy, and apply them to contemporary and notional conflicts. Develops military thinkers who can form creative solutions to complex military problems.

MSS 365. Developing the Military Strategist. Builds on a foundation of strategic theory to consider contemporary issues from an air, space and cyberspace power perspective. Content explores propositions of air, space and cyberspace doctrine and theories, examines various approaches to employment of military power, and considers characteristics of air, space and cyberspace capabilities and requirements.

MSS 369. Strategy and Society. Examines the impact of societal groups, organizations, and issues on the formulation and execution of military strategy. Special emphasis is given to contemporary concerns that affect military roles, missions, identities, effectiveness, plans and operations in joint, interagency and coalition environments.

MSS 379. Research Methods in Military Strategic Studies. Introduces and explains research methods and their application to military strategic studies. Provides the foundation for a range of qualitative and quantitative research designs, tools, processes and resources to analyze military issues including strategy, theory, doctrine, force structure and operations. Seminar director assigns each student a faculty thesis advisor to provide additional research mentorship. Course concludes with a final paper that will be developed into a thesis in MSS 498.

MSS 385. Special Operations. Course is designed to educate future Airmen regarding the capabilities, limitations and potential for employing special operations forces (SOF) at the operational and strategic levels. In addition, it develops critical thinking skills by requiring analysis, problem-solving and application of theoretical concepts to real-world situations. It traces the evolution of SOF capabilities and evaluates the reasons behind successes and failures. Case studies are incorporated for comparison with contemporary operations and introduction of a common framework.

MSS 400. Joint and Coalition Operations. Course introduces the capabilities of all U.S. military services, with emphasis on individual service cultures and doctrine. It culminates by synergistically leveraging service-specific capabilities in a joint war fighting simulation. It also explores integration of special operations and coalition forces in war fighting. Teamwork is emphasized. War-gaming scenarios and teaching cases reinforce and validate concepts taught in the classroom.

MSS 410. Advanced Studies in Joint and Coalition Operations. Course introduces the cultures, organization, doctrines and capabilities of all U.S. military services. Discussions also include the National Military Strategy, the organization for National Security, the Unified Command structure and the critical role of special operations forces. Once this foundation is set, classroom discussions center on joint U.S. and coalition operations in specific areas of Military Operations Other Than War (MOOTW). These areas include, but are not limited to, terrorism, proliferation of Weapons of Mass Destruction (WMD), peace operations, humanitarian relief and stability operations.

MSS 462. Military Innovation and Transformation. Military strategy, operations and theory reflect efforts to shape institutions, ideas and organizations. Armed forces are involved in various processes of invention, innovation and potentially transformation to meet emerging threats. Students develop and apply critical inquiry to comprehend complexities of innovation and transformation during peacetime and wartime. Case studies of American and foreign military change are examined to evaluate processes of successful–and failed–military innovations and their relationship to service transformation.

MSS 463. Irregular Warfare and Armed Groups. Examines the challenges armed groups employing irregular warfare strategies pose to the U.S. and its allies. Students explore and evaluate alternative approaches for meeting these diverse threats and consider frameworks for analyzing the complex strategic challenges associated with armed groups and irregular warfare.

MSS 465. Integrating Operations in Air, Space and Cyberspace. A laboratory-intensive course in which students strategize, plan and adaptively execute Air Force operations. Students examine air, space and cyberspace missions, various weapon and sensor platforms, and generate combined effects. They explore the application of Air Force capabilities in current, emerging, and notional threat contexts via the Applied Strategy Laboratory, Air Warfare Laboratory, Space Operations Laboratory, and other laboratories as appropriate.

MSS 470. Information and Cyberspace Operations. Examines information operations and cyberspace capabilities and strategies by means of a thorough study of influence operations, network warfare operations and electronic warfare operations. Analyzes the current and emerging influence of information operations on force structure, strategy and operational capabilities together with an assessment of the crucial role of information dominance across the spectrum of war.

MSS 477. Airpower. Students in this course gain an appreciation for the complexity and necessity of air campaign planning and the medium of air warfare in general. They'll delve deeply into current U.S. airpower operational concepts. The course explores not only weapons platforms, sensors and munitions, but also roles, missions and types of aerial warfare useful in the joint environment. It evaluates manned and unmanned air missions, as well as each platform's advantages and disadvantages. The ultimate goal is to provide an opportunity to understand the complexity and criticality of planning Joint Operations Plans and Air Tasking Orders and then allowing students to wargame their efforts.

MSS 485. Space as an Element of National Power. Seminar discusses conceptual frameworks to understand the context, theory and application of space as an element of national power. Students contextually understand the intellectual foundations of space strategy and theory for American and foreign space powers, as well as contemporary and notional future space capabilities. Students explore selected concepts and capabilities in the Space Operations Education Lab.

MSS 490. Military Strategies of Asia and the Pacific. Seminar focused on strategic military assumptions, processes and interactions in the region. Comprehend current and emerging military operational environments in the United States Pacific Command (USPACOM) Area of Responsibility (AOR), develop regional knowledge and analytical skills, and practice decision-making in realistic scenarios. This AOR primarily comprises India, Australia, East Asia and the Pacific. Regional context will include selected threats, concepts and issues related to contemporary military strategy.

MSS 491. Military Strategies of North America. Seminar focuses on strategic military assumptions, processes and interactions in the region. Comprehend current and emerging military operational environments in the United States Northern Command (USNORTHCOM) Area of Responsibility (AOR), develop regional knowledge and analytical skills, and practice decision-making in realistic scenarios. This AOR primarily comprises the continental United States, Alaska, Canada and Mexico. Regional context will include U.S. homeland defense and selected threats, concepts and issues related to contemporary military strategy.

MSS 492. Military Strategies of Latin America. Seminar focuses on strategic military assumptions, processes and interactions in the region. Comprehend current and emerging military operational environments in the United States Southern Command (USSOUTHCOM) Area of Responsibility (AOR), develop regional knowledge and analytical skills, and practice decision-making in realistic scenarios. This AOR primarily comprises Central America, the Caribbean and South America. Regional context will include selected threats, concepts and issues related to contemporary military strategy.

MSS 493. Military Strategies of Europe and Russia. Seminar focuses on strategic military assumptions, processes and interactions in the region. Comprehend current and emerging operational environments in the United States European (USEUCOM) Area of Responsibility (AOR), develop regional knowledge and analytical skills, and practice decision-making in realistic scenarios. This AOR primarily comprises Europe, Russia, Turkey and Israel. Regional context will include selected threats, concepts and issues related to contemporary military strategy.

MSS 494. Military Strategies of Africa. Seminar focuses on strategic military assumptions, processes and interactions in the region. Comprehend current and emerging operational environments in the United States Africa Command (USAFRICOM) Area of Responsibility (AOR), develop regional knowledge and analytical skills, and practice decision-making in realistic scenarios. This AOR primarily comprises the African continent, minus Egypt. Regional context will include selected threats, concepts and issues related to contemporary military strategy.

MSS 495. Special Topics. Selected topics related to military doctrine, operations and strategy.

MSS 496. Military Strategies of Western and Central Asia. Seminar focuses on strategic military assumptions, processes and interactions in the region. Comprehend current and emerging military operational environments in the United States Central Command (USCENTCOM) Area of Responsibility (AOR), develop regional knowledge and analytical skills, and practice decision-making in realistic scenarios. This AOR primarily comprises Egypt, Southwest Asia and Central Asia including Pakistan, Central America, the Caribbean and South America. Regional context will include selected threats, concepts and issues related to contemporary military strategy.

MSS 498. Capstone Thesis in Military Strategic Studies. Course provides an opportunity for all MSS majors to participate in higher-level discussions and learning that combine all aspects of previous MSS coursework. In addition, it offers an opportunity for each MSS major to work closely with their thesis advisor to complete a major paper for publication on the topics included within the genre of military strategic studies.

MSS 499. Independent Study. Individual study and/or research under the direction of a military strategic studies instructor.

The following are additional course offerings from the Department of Military Strategic Studies.

AVIATION (Aviation)
Offered by the Department of Military Strategic Studies (DFMI).

Aviation 495. Special Topics in Aviation. Selected special topics courses in aviation.

Aviation 499. Independent Research and Study. Individual study and research in aviation under the direction of a MSS academic instructor.

operations research major

Operations research (OR) is the application of quantitative techniques to managerial decision-making. To gain an appreciation for the field, it is necessary to look at the origins of operations research.

Operations research, as a discipline, arose from the need to determine optimal resource allocation and assist decision makers during World War II. Groups of mathematicians, physical scientists and economists were assembled to perform studies that would provide quantitative input for commanders. The results of their efforts were impressive, and soon thereafter, the commercial sector realized the power of these new planning techniques.

Using mathematics to model real world systems was nothing new; physicists and economists had been doing it for years. What defined this new field called OR was its focus on the operations of organizations. Not only were traditional mathematical modeling methods used, such as statistics and probability, but new modeling methods, such as mathematical programming and queuing theory were created.

Operations research, therefore, entails the development and application of new quantitative modeling methods to real management and economics problems. This is an exciting field—one that attracts curious problem-solvers who are strong in mathematics and computer science and are eager to solve real world problems.

The description of OR provided above highlights its interdisciplinary nature. The Academy has captured the essence of the field by establishing a truly interdisciplinary major. The OR program is jointly administered by the Departments of Computer Science, Economics and Geosciences, Management and Mathematical Sciences. In addition to the basic set of OR courses, the required major's courses will include courses from each of the four departments.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt
Econ 201	Beh Sci 310	Astro Engr 410
ECE 231	Biology 315	Econ 465
English 211	Comp Sci 211	Econ 466
Engr Mech 220	Comp Sci 362	English 411
Law 220	History 302	Mgt 400
Math 243	Math 377	MSS 400
Math 344	Math 378	Ops Rsch 419
MSS 200	Ops Rsch 321	Ops Rsch 420
Physics 215	Ops Rsch 330	Ops Rsch Opt 1
Pol Sci 211	Ops Rsch 411	Ops Rsch Opt 2
Sys Opt Ops Rsch 310	Philos 310	Soc Sci 412

OPERATIONS RESEARCH (Ops Rsch)
Offered by the Departments of Computer Science (DFCS), Economics and Geosciences (DFEG), Management (DFM) and Mathematical Sciences (DFMS).

Ops Rsch 310. Systems Analysis. Course provides an introduction to quantitative modeling methods that have broad application. Focuses on computer implementation of models and application of these models to practical decision-making scenarios. By demonstrating the application of these techniques to problems in a wide range of disciplines, the course is relevant to technical and non-technical majors at the Academy. Covers OR tools such as optimization, queuing, simulation and decision analysis.

Ops Rsch 321. Probabilistic Models. Selected probabilistic models (such as random walks, Markov Chains, queues and reliability models) are analyzed as stochastic processes.

Ops Rsch 330. Economic Theory and Operations Analysis. Calculus-based intermediate microeconomic theory for students majoring in operations research. Within decision-making environments such as the Department of Defense (DOD), large corporations or private firms, optimization directs how resources are to be efficiently allocated. Draws parallels between an optimized solution derived by calculation and efficient solutions that market processes generate. Emphasizes economic processes as a foundation of optimization and the microeconomic interpretation of solutions to constrained optimization (Kuhn-Tucker) problems. Students cannot receive credit for Ops Rsch 330 in addition to Econ 333 or Mgt 423.

Ops Rsch 405. Operations Research Seminar. A course for OR majors that provides for presentation of student and faculty research, guest lectures, field trips, seminars on career and graduate school opportunities for scientific analysts in the Air Force, goal setting exercises and applications of OR.

Ops Rsch 411. Topics in Mathematical Programming. Topics include linear programming (with sensitivity analysis and applications) and non-linear programming. Addresses both the theory and the computer implementation of these techniques.

Ops Rsch 419. Capstone in Operations Research: Case Studies. Study of methodologies associated with business and operations management. Case-based course intended to provide the proper foundation needed to conduct effective analyses supporting a variety of scenarios. Students evaluate various cases, develop plans for and conduct analyses and create effective written and oral presentations. Develop capstone project proposal for Ops Rsch 420.

Ops Rsch 420. Capstone in Operations Research. Project development and implementation for real-world clients using advanced operations research techniques with emphasis on problem recognition, model formulation and Air Force applications.

Ops Rsch 495. Special Topics. Selected advanced topics in OR.

Ops Rsch 499. Independent Study. Individual study and/or research in OR under the supervision of a faculty member.

philosophy minor

The philosophy minor requires a minimum of 147 hours and four philosophy courses in addition to Philos 310. Because philosophy courses can often be used to fulfill a major's requirements in other disciplines, the philosophy minor can sometimes be earned by taking only one or two additional courses.

"Philosophy" is not another discipline. Rather, it is rational inquiry into any discipline (e.g., philosophy of psychology, philosophy of history, philosophy of law). Philosophers seek answers to the basic, fundamental questions which underpin any field of study. In addition to the questions addressed in the core course about how we should live our lives, philosophers also study: principles of language and reasoning (logic); foundations of empirical discovery and other ways of knowing (epistemology); and the ultimate underpinnings and structure of the self and the world (metaphysics).

Philosophy is an ancient and valuable sub district within the vast marketplace of ideas. It is concerned with the most interesting questions in life—the questions that are fundamental and the least easy to answer or avoid. All students are required to take a course in ethics, which is the discipline concerned with answering the questions: What is a good act? What sort of person is the best person? What is truly valuable? By what principles should life be led? Obviously, philosophy is not for everyone. It is not for those who want easy answers, nor is it for those who do not care about the deeper meanings of life or the purpose of their own lives. It is for those who wish to gain a more thorough understanding of themselves as rational, reflective beings inhabiting and working in a world that sometimes allows us to glimpse its deeper meanings.

Course Requirements

A. Four courses (12 semester hours) in addition to Philosophy 310 in which the student earns a grade of "C" or better.
B. Required courses include:
1. Philos 390: The Great Philosophers
2. One of the following logic courses:
Philos 360:
Philos 370:
Applied Reasoning
Introduction to Symbolic Logic
3/4. Any two philosophy courses not taken above.

NOTE: See course descriptions under the humanities major.

physics major

Physics involves the study of the small and very small (atoms, molecules, nuclei and elementary particles), the large and very large (the Earth, moon, solar system, stars, galaxies and the universe), the strange (black holes, anti-matter and superconductivity), the common (swings on playgrounds, springs and wheels), the relevant (space systems sensors and the motions of aircraft and satellites) and just about anything else! In other words, the scope of physics is limited only by the imagination of the physicist. Because the scope of physics is so broad, a physicist must be a generalist who can see the underlying connections between diverse topics. As a result, the physics major concentrates on the basic physical and mathematical principles that help us understand the world. This is also why the physics major is so flexible; a student's vision can help them design a physics sequence that fits their role as an Air Force officer. The physics curriculum blends traditional academic instruction, practical laboratory work and independent research projects to develop the ability to think creatively and analytically.

The physics major has a reputation for being challenging, but its rewards are great. It prepares students for a successful career in the increasingly technical Air Force and reward them with satisfaction in mastering a rigorous, demanding discipline. Physics is never obsolete; it forms the foundation upon which new technologies rest. Whether operational or scientific in nature, the technical innovations in today's Air Force have physics as their fundamental element.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt
Econ 201	Beh Sci 310	Astro Engr 410
ECE 231	Biology 315	English 411
English 211	History 302	Mgt 400
Engr Mech 220	Math 346	MSS 400
Law 220	Math 356	Physics 405 (Seminar)
Math 243	Philos 310	Physics 465
Math 245	Physics 341	Physics 490
MSS 200	Physics 355	Physics Conc 1
Physics 215	Physics 356	Physics Conc 2
Physics 264	Physics 361	Physics Conc 3
Pol Sci 211	Physics 362	Soc Sci 412
		Sys Opt Physics 421

PHYSICS (Physics)
Offered by the Department of Physics (DFP).

Physics 110. General Physics I. Introductory calculus-based physics course with emphasis on contemporary applications (first semester). Topics include Newtonian mechanics (statics and dynamics); conservation of energy, momentum, rotational motion, Universal Law of Gravitation and motion in gravitational fields, Kepler's Laws and waves. Possible additional topics include angular momentum, oscillations, special relativity, fluids and thermodynamics. Emphasizes the use of vectors and calculus in problem solving. Course includes in-class laboratories and computer applications to highlight key concepts.

Physics 215. General Physics II. Introductory calculus-based physics course with emphasis on contemporary applications (second semester). Topics include electrostatics, simple DC circuits, magnetic fields, electromagnetic induction, electromagnetic waves and physical optics. Possible additional topics include: simple AC circuits and applications, geometric optics and selected topics in modern physics. Emphasizes use of vectors and calculus in problem solving. Course includes in-class laboratories and computer applications to highlight key concepts. Highly desirable to be taken in the semester immediately following the successful completion of Physics 110.

Physics 264. Modern Physics. Introduction to the special theory of relativity and a historically-based development of quantum theory. Investigation of Bohr model of the atom. Introduction to quantum mechanics and its application to problems involving simple forms of potential energy. Possible application topics include atomic and molecular physics, solid state physics, nuclear reactions and decay and elementary particles.

Physics 310. Principles of Nuclear Engineering. Survey course in aerospace uses of nuclear energy. Course introduces the student to the sources and uses of nuclear energy from radioactive decay, fission and fusion. It covers such topics as nuclear space propulsion and power; ground-based nuclear power; the production, effects and detection of nuclear weapons; the protection of man and aerospace assets from nuclear radiation; and the safe disposal of radioactive waste.

Physics 315. Combat Aviation Physics. Broad-based study of the principles of physics as they directly apply to the realm of combat aviation. Course covers three topical areas: the physics of flight as a dynamic investigation of forces and energy applied to the combat maneuvering required to win air-to-air engagements; the combat use of the electromagnetic spectrum, primarily as it applies to radar, IR seekers and countermeasures; and the physics behind the employment of air-to-ground weapons.

Physics 341. Laboratory Techniques. Introductory laboratory course developing skills in experimental techniques and data analysis. Course includes instruction in using various types of electronic instrumentation and devices to analyze and design electrical circuits. Experiments will investigate the laws and principles of modern physics taught in Physics 264.

Physics 355. Classical Mechanics. Examination of the underlying classical laws governing the general motion of bodies. The topics covered include vector calculus, Newtonian dynamics, Lagrangian and Hamiltonian dynamics, the law of gravity and central-force motion, two-particle collisions and scattering. Possible other topics include linear and coupled oscillations, noninertial reference frames, chaos, transformation properties of orthogonal coordinate systems and rigid-body motion. Extensive application of calculus, ordinary differential equations and linear algebra will be made in the solution of problems.

Physics 356. Computational Physics. Introduction to solving complex physical problems using numerical techniques. Subjects covered may include: kinematics, damped/driven oscillators, nonlinear dynamics, chaos, coupled oscillators, waves, thermal diffusion and electromagnetic potentials. Methods presented include regression analysis, numerical differentiation, and solutions to ordinary and partial differential equations.

Physics 361. Electromagnetic Theory I. Develops Maxwell's equations and basic principles of electromagnetism. Includes electrostatic fields in both vacuum and in dielectrics, the Laplace and Poisson equations, magnetic fields associated with constant and time varying currents and magnetic materials.

Physics 362. Electromagnetic Theory II. Application of Maxwell's equations: plane waves, reflection, refraction, guided waves, electric and magnetic dipoles, and quadruples and antennas. The interaction between plane waves and plasmas is treated. Basics of relativistic electrodynamics are introduced.

Physics 370. Upper Atmospheric and Geo-Space Physics. Survey course on the composition and physics of the upper atmosphere and near-earth environment. Topics include solar-terrestrial interactions; observations, phenomena and military operations in the near-earth environment; structure, dynamics and transport in the upper atmosphere; and energy transfer, remote-sensing and military operations in the upper atmosphere.

Physics 371. Astronomy. Calculus-based study of the fundamental concepts of astronomy. Emphasizes understanding the basic physical concepts that explain stellar structure, stellar evolution, galactic structure, the solar system and the origin of the universe. Includes up to three night classes at the Academy observatory.

Physics 375. Physics of Space Situational Awareness. Survey course in the application of physics principles and their constraints to space situational awareness (SSA). SSA of space objects can be thought of in terms of where it is and how did it get there, what it is and has it changed, and do we need to worry about it? The answers to these questions are crucial in deriving actionable knowledge for national defense. Topics include space surveillance using radar and electro-optical sensors; orbit determination and prediction; high-resolution imagery; non-resolvable space object identification; and military operations in space and mission impacts.

Physics 391. Introduction to Optics and Lasers. Survey course in optics. Including geometrical optics (lenses, mirrors, ray tracing and optical instruments); physical optics (interference, diffraction, polarization, spectra and scattering); introduction to lasers (laser operation, pumping, resonators and optical cavities); and contemporary topics (Fourier optics, imaging and holography).

Physics 393. Solid State Physics. Introduction to the physics of the solid state nature of matter. Crystal structure, crystal binding, lattice vibration, free electron theory and band theory. Basic introduction to quantum theory and quantum statistics of solids. Theories are used to explain metals, semiconductors and insulators. Survey topics include magnetism, superconductivity, optical phenomena in solids, crystal imperfections and the physics of solid state devices.

Physics 405. Physics Seminar. A professional development course emphasizing skills useful for physics research. Gives students enrolled in Physics 490 an opportunity to present results of their research, receive training in specific research skills, and have discussions with experienced faculty researchers regarding such topics as professional ethics and contemporary issues.

Physics 421. Thermal and Statistical Physics. Classical thermodynamics with an emphasis on thermodynamic laws and applications to cycles. Kinetic theory, statistical thermodynamics and quantum statistics. Applications of statistics to quantum systems.

Physics 451. Plasma Physics. A comprehensive introduction to the plasma state of matter. Topics include single particle motion, adiabatic invariants, fluid description of a plasma, waves in plasmas, kinetic theory, diffusion and resistivity, and stability. Emphasizes application of plasma physics principles to solar-planetary interactions and space vehicle operations.

Physics 465. Quantum Mechanics. Basic principles of quantum mechanics. Postulates. Dirac notation. Schrodinger's equation. Operators, eigenfunctions and eigenvalues. Potential barriers and wells. Simple harmonic oscillator. Orbital and spin angular momentum. Addition of total angular momentum. Hydrogen atom. Elementary radiation theory. Time independent perturbation theory. Two-level systems. Stark effect. Fine structure.

Physics 468. Atomic and Nuclear Physics. Treatment of the fundamental physical concepts governing all of microscopic physics which includes elementary particle, nuclear, atomic and molecular physics. The topics covered include the standard model of elementary particles and interactions symmetries and conservation laws, gauge theories, properties of the nucleus, nuclear models, nuclear interactions and decays, scattering theory, atomic systems and atomic and molecular spectroscopy techniques.

Physics 482. Laser Physics and Modern Optics. Detailed study of the operation of the laser: types of lasers, lasing media, pumping mechanisms, resonators and cavities, laser modes and Gaussian properties. Covers modern optics, introductory electro-optics, nonlinear optics, statistical optics and quantum mechanical analogs of optical systems.

Physics 486. Astrophysics. Applications of physics to astrophysical problems and topics of current interest in astrophysics. Typical topics include stellar structure and evolution, supernovae, white dwarfs, neutron stars, black holes, galactic structure, active galaxies, quasars, cosmology and general relativity. The choice of topics depends on instructor and student preferences.

Physics 490. Capstone Physics Research. A research experience course where cadets work in small teams to conduct original research in one area of physics, including lasers/optics, space physics, astronomy, physics education or other physics subdiscipline. During the semester, each team will work on a single project and experience the full range of the research process, including planning and implementing a research project, analyzing data and reporting results in technical written reports and oral presentations. Some cadets will publish their work in professional journals.

Physics 495. Special Topics. Selected topics in physics.

Physics 499. Independent Study. Individual research under the direction of a faculty member.

political science major

The political science major offers a course of studies tailored to the needs of prospective Air Force officers by providing a comprehensive understanding of both the substance and process of politics and public policy. The major is uniquely capable of preparing students to comprehend the political events, both domestic and international, that will shape their careers. It accomplishes this by examining topics such as political theories and ideologies, comparative politics, international relations, American politics, international security, defense decision-making, the politics of foreign governments, organizational behavior and political economy.

The political science major is very flexible. The major allows students to study areas in-depth or to examine a variety of political topics. In addition, students who wish to earn a foreign language minor may take all four required upper-level language courses within the political science major. A Philosophy minor can be earned with minimal extra classes as well. The major offers four areas of concentration: American politics, international politics, comparative politics and area studies, and national security policy. Students can also work with their advisors to tailor an academic program to meet their individual needs.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt
Econ 201	Beh Sci 310	Astro Engr 410
English 211	Biology 315	English 411
Engr Mech 220	ECE 315	Mgt 400
For Lang 3	Math 300	MSS 400
For Lang 4	Philos 310	Pol Sci 491
History 302	Pol Sci 300	Pol Sci Basket 3
Law 220	Pol Sci 301	Pol Sci Opt
MSS 200	Pol Sci 302	Pol Sci Opt
Physics 215	Pol Sci Basket 1	Pol Sci Opt
Pol Sci 211	Pol Sci Basket 2	Pol Sci Opt
Soc Sci 212	Sys Opt	Soc Sci/Hum Opt

POLITICAL SCIENCE (Pol Sci)
Offered by the Department of Political Science (DFPS).

Pol Sci 211. Politics, American Government and National Security. Introduces students to the study of politics and government and examines the basic ideological, structural and procedural choices faced by any political system. Special emphasis is given to an understanding of the foundations and traditions of American democracy and the structure, decision processes and policy outcomes, especially defense policy outputs, of the American political system. Students examine current policy issues that affect the military.

Pol Sci 300. Introduction to Political Science: Overview and Methods. Provides an introduction to the discipline. Introduces students to the methods used in political science, emphasizing the process of research design–from coming up with a hypothesis, to determining how to test that hypothesis, to how to present the conclusions of the research. Research approaches presented are essential to the political science major and of great benefit to students in other majors that require the systematic examination of research questions.

Pol Sci 301. Political Theory. An overview of political thought from the ancient Greeks to the present. Philosophers studied include Plato, Aristotle, Augustine, Aquinas, Machiavelli, Hobbes, Locke, Montesquieu, Rousseau, Marx and Nietzsche. Examines debates important for Airman-scholars and the political science major: human nature, the best regime, justice, equality, freedom, community, natural rights, religion, and comparative and national security politics.

Pol Sci 302. Politics of National Security. Explores concepts formulated by great thinkers in response to security challenges, from the wars of Ancient Greece through the Cold War to September 11th, to shape our assessment of the way in which the U.S. employs its power. Applies all the subfields and methods of political science to the study of national security. Prepares students for advanced electives in international relations, American and comparative politics, and complements professionally oriented courses on contemporary security problems in the context of American grand strategy.

Pol Sci 390. International Relations Theory. Introduces the basic concepts of international relations. Major theoretical approaches to the analysis of international politics (realism, liberalism and globalism) are used to explore the nature of the international system and various aspects of state behavior in their historical and contemporary settings. Among the subjects examined within this framework: the formulation of foreign policy, mechanisms of conflict and cooperation, the origins of war, issues of international interdependence, international political economy and questions of international ethics.

Pol Sci 392. American Political System and Theory. Explores the origin and development of American political ideas and institutions. Examines the notion of American exceptionalism and the design and operation of the American system. Topics include: American constitutional design and its consequences; the expression of preferences; the analysis of institutional behavior; and the policy process.

Pol Sci 394. Comparative Government and Politics. Introduces major theoretical approaches to the comparative study of politics. Applies these approaches to topics like government institutions, political participation and social change as they relate to various state and nonstate actors.

Pol Sci 421. International Security: Political Violence and Terrorism. Applies theories of international security to the roots and forms of political violence in a globalized era. Examines the sub-national and transnational sources of conflict as well as the impact of globalization on the character of collective violence. Investigates the emergence, motivations and strategies of violent nonstate actors with emphasis on ethno-political groups, militant religious movements, transnational criminal organizations, warlords and insurgencies. Focuses on the use of terrorism to achieve political objectives.

Pol Sci 423. War Crimes, Genocide and Human Rights. Explores historical, legal and political perspectives on the law of armed conflict and the development of human rights law. The Nuremberg Tribunals, the Holocaust, the Cambodian and Rwandan genocides, the My Lai incident and experiences of prisoners of war are used as case studies within this framework. Resistance movements are also examined. Course is team taught by members of the political science, law and history departments and can be used as a social science elective or an elective in any of these three departments.

Pol Sci 444. International Political Economy. Explores the theory and practice of how economic motives affect political decisions and how most political decisions have economic repercussions, both domestically and internationally. Specific topics include the development of the international monetary system, international trade policy, the effects of multinational corporations, foreign direct investment, development of the Global South and contemporary issues such as the recent Asian financial crisis.

Pol Sci 445. International Organizations and Global Issues. Examines the role and interrelationships of international organizations, nation states and nonstate actors in the global system. North-South and East-West relations are discussed in terms of pertinent global issues: crisis management, conflict resolution, human rights, refugee problems, international finance, world trade and economic aid programs.

Pol Sci 451. American Political Thought. Surveys basic themes in American political thought beginning with the 17th century European origins of American political thought and extending to modern attempts to strike a balance between individual rights and social needs. Focuses on the difficulties of translating principles into practice.

Pol Sci 460. Comparative Security Policy and Civil-Military Relations. Studies the security policies and policy-making processes of various world regions as well as the national and regional implications of both traditional and nontraditional security issues. Examines the relationship between civilian authorities and the military establishment and the implications for governance. Specific cases help develop individual skills in analyzing national security priorities in the post-Cold War world.

Pol Sci 462. Politics and Intelligence. Explores the character of secrecy in the American democratic system. Investigates the role of intelligence in the development and implementation of U.S. national security policy. Focuses on the key players in the intelligence community, the capabilities of intelligence systems, the tradecraft of spying and the core intelligence functions of collection, analysis, covert action and counterintelligence. Includes examination of the roles and contributions of military intelligence and current issues in the intelligence field.

Pol Sci 464. Democratization: The Theory and Practice of State Building. The movement worldwide from authoritarianism to democracy has been the major political event of our generation. This trend to democratic governance is coupled with the U.S. military's increasing role in establishing and fostering not only the institutions of state, but the environment that ensures liberal governance. Course explores democratization, the means and methods that the 70-plus countries since the mid-1970s have employed in their movement toward a democratic regime.

Pol Sci 465. U.S. National Space Policy. Examines the evolution, major influences on, and consequences of U.S. national space policy. Focuses on the relationships among politics, policy-making processes, law and technology as they relate to the civil, military, commercial and intelligence space sectors. Addresses the rights and responsibilities of states in the use of outer space. Topics include NASA space strategies; military space missions; commercial space trends; intelligence function; international agreements; sovereignty over air, space and celestial bodies; and government liability.

Pol Sci 469. Politics of Russia, Eastern Europe and Eurasia. Examines historic, cultural, economic, social and geographic traits that distinguish Russia and its neighbors and shape their domestic political processes and interstate relations. Critically compares the politics, governments and orientations of post-Soviet states. Surveys contemporary regional issues such as ethnic conflict, nationalism and politico-economic reforms, with a particular emphasis on security concerns.

Pol Sci 471. Politics of Europe. Examines historic, cultural, economic, social and geographic traits that distinguish this region and shape its domestic political processes and interstate relations. Critically compares the politics, governments and orientations of European states and important regional powers. Surveys contemporary issues such as democratization, arms control and regional integration, with a particular emphasis on security concerns.

Pol Sci 473. Politics of Asia. Examines historic, cultural, economic, social and geographic traits that distinguish this region and shape its domestic political processes and interstate relations. Surveys the governments of selected countries. Examines in particular the influence of Japan and China on regional and global affairs. Includes a survey of contemporary multilateral issues salient in the region, with particular focus on regional security concerns.

Pol Sci 475. Politics of Latin America. Examines historic, cultural, economic, social and geographic traits that distinguish this region and shape its domestic political processes and interstate relations. Selected Latin American political systems are explored in detail. Issues such as political stability, civil-military relations and democratization are treated as well, along with politico-economic concerns such as developmental strategies, debt relief and trade relations. Includes a survey of contemporary multilateral issues salient in the region, with particular focus on regional security concerns.

Pol Sci 477. Politics of the Middle East. Examines historic, cultural, economic, social, religious and geographic traits that distinguish the region extending from North Africa through Central Asia and shape its domestic political processes and interstate relations. Surveys the governments of selected countries, considering factors such as legitimacy and political development. Includes a survey of contemporary multilateral issues with particular focus on regional security concerns.

Pol Sci 479. Politics of Sub-Saharan Africa. Examines historic, cultural, economic, social, religious and geographic traits that distinguish the states of sub-Saharan Africa and their domestic political processes and interstate relations. Critically compares the politics, governments and orientations of selected African states. Surveys contemporary regional issues with a particular emphasis on security concerns.

Pol Sci 481. American Elections and Political Parties. Examines the nature of the electoral process and the roles that candidates, political parties, public opinion and interest groups play in the process. Focuses on the role of candidates' election organizations, political parties, professional campaign managers, public opinion pollsters, professional fundraisers and media consultants in congressional and presidential campaigns. Special attention is given to the current presidential or congressional elections.

Pol Sci 482. The U.S. Supreme Court. The Supreme Court is extremely influential in American politics, sometimes even acting as a policy-making body, deciding the fate of such contentious matters as abortion, capital punishment, public expressions of religious belief and even a presidential election. Examines the court's rulings in these areas and many others, focusing on the written opinions, the thoughts of those who designed our government, and competing views about the court's proper role in our system of separated powers.

Pol Sci 483. The U.S. Congress. Studies Congress as a political institution, with an emphasis on the unique natures of the House and the Senate, congressional norms and procedures, and the roles of committees and political parties. Topics include elections, member-constituent relations, national policy roles, leadership, the committee system, legislative procedures, legislative oversight of the executive branch, and the effects of public opinion and interest groups on law making.

Pol Sci 484. The American Presidency. Provides an in-depth study of the presidency with emphasis on the post-World War II period. Examines the presidential selection process and the office and powers of the president, as well as presidential administrative structures, styles, roles and personalities.

Pol Sci 486. American Foreign Policy. Examines the evolution of American foreign policy with the ever-changing global environment. Analyzes the domestic context of policy and the policy process itself, along with the importance of the Constitution and the institutions of government to foreign policy making. Pays special attention to the tools of foreign and national security policy and employs case studies to highlight important features and dilemmas of the policy making process.

Pol Sci 491. Capstone Seminar in Political Science. The culmination of the political science curriculum. Focuses on practical political and military issues. These include how soldiers have reacted in battle from ancient time to the present; how hierarchical authoritarian organizations operate, their strengths and weaknesses and what strategies tend to be successful for achieving positive outcomes; the relationship between capabilities and national strategies; and how personality, bureaucratic politics, perceptions and experience shape policy.

Pol Sci 495. Special Topics in Political Science. Selected topics in political science, taught in seminar format. One field trip per semester when appropriate local destinations are available.

Pol Sci 496. Causes of War and Conflict Resolution. Examines the causes, conduct and consequences of international conflict, interventions, crises and wars and the theory and practice of conflict resolution. Course uses wars from around the world, drawn from different historical periods, focusing on both theoretical and normative issues. Special attention is paid to wars involving the U. S., including ongoing interventions.

Pol Sci 498. Political Science Thesis. Students enrolled in this course prepare a 50-75 page senior thesis under the guidance of the course director and other faculty members with particular expertise on the topic of research. It combines the tutorial aspect of an independent study (Pol Sci 499) with seminar on applied research methods. Students meet individually or in seminar in accordance with a schedule determined by the course director. Formulation of thesis and research normally begins in Pol Sci 300 and other political science courses. When the thesis is completed, a formal defense is presented to a faculty committee in April or May. In preparation for the formal defense, each thesis is presented to fellow students in the seminar for critique and evaluation.

Pol Sci 499. Independent Study in Political Science. Individual study or research of a carefully selected topic conducted on a tutorial basis.

social sciences major

Social sciences deal with human behavior in its social and cultural aspects. At the Air Force Academy, the following disciplines are within the social sciences: economics, geospatial science, management, law, political science and behavioral sciences. Additionally, courses offered by military strategic studies can also be used to fulfill *some* of the major's requirements.

The major in social sciences is designed for the student whose interests and abilities lie in a broader program of study than a single disciplinary major would provide. The social sciences major requires completion of at least one course in economics, management, law, political science and behavioral sciences. More concentrated study in one discipline is possible through social science divisional options (any course(s) from the social science disciplines *in addition to* military strategic studies). Flexibility in course selection is one advantage of this major. A specialized degree in a particular discipline would be an option after graduation.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Breadth Opt 1	Aero Engr 315	Academic Div Opt
Chem 200	Beh Sci 310	Academy Opt
Econ 201	Biology 315	Astro Engr 410
English 211	Breadth Opt 2	Depth Opt 2
Engr Mech 220	Breadth Opt 3	Depth Opt 3
For Lang 3	Breadth Opt 4	Depth Opt 4
For Lang 4	Breadth Opt 5	English 411
Law 220	Depth Opt 1	Mgt 400
MSS 200	ECE 315	MSS 400
Physics 215	History 302	Soc Sci 412
Pol Sci 211	Math 300	
Sys Opt	Philos 310	

SOCIAL SCIENCES (Soc Sci)
Offered by the various departments within the social sciences division.

Soc Sci 212. Geopolitics. Integrated course provides the primary experience to facilitate student understanding of the global environment into which they will deploy. The global environment includes international relations, comparative politics, global gender roles and culture and examines how these factors influence global and national politics. Students will describe, interpret and evaluate global political relations and formulate strategies for interacting in Western and non-Western cultures. A core substitute for Soc Sci 412 for students requiring this material early in their major.

Soc Sci 400. Social Sciences Seminar. Interdisciplinary interactive seminar focused on relevant social sciences topics.

Soc Sci 401. Social Sciences Divisional Core Substitute. Course can only be awarded for coursework accomplished during a semester of study abroad (CSSAP), international exchange (CSEAP) or service academy exchange (SAEP). Can fulfill the core requirement for Beh Sci 310, Mgt 400 or Soc Sci 412 with applicable department head or division chair approval.

Soc Sci 412. Geopolitics. Integrated interdisciplinary course provides the primary experience to facilitate senior student understanding of the global environment into which they will deploy. The global environment includes international relations, comparative politics, global gender roles, culture and physical process and examines how these factors influence global and national politics. Students will describe, interpret and evaluate global political relations and formulate strategies for interacting in Western and non-Western cultures.

Soc Sci 420. Law and Economics. Interdisciplinary course examining various legal issues from an economics perspective. Employs basic economic principles to understand the nature of legal rules, their effect on society and to suggest how these rules might be reformed. Framework is applied to tort, criminal, contract and property law.

Soc Sci 483. Principles of Negotiation. Studies the process of negotiation in a variety of situations, ranging from negotiating one-on-one with family members to resolving complex multi-party disputes. Students experience two distinct methods of negotiation: the distributive bargaining and the interest-based approach. Students prepare for, conduct and analyze negotiations to include critical analysis of self and others. Emphasizing listening as an essential capability.

Soc Sci 495S. Statesmanship. Capstone seminar course for the Academy Scholars Program focused on statesmanship.

space operations major

The space operations major is an interdisciplinary program with primary emphasis on preparing students for a career in space operations. The major is designed to develop Air Force officers with a technical background in space and an understanding of contemporary problems and issues peculiar to space. Course work in science, geospatial science, mathematics and astronautics provides the technical background required for this field. Coupled with courses in space history, law, policy and military doctrine, this program provides the breadth of education required for this growing field. The space operations major provides the student with excellent preparation for entering a graduate program in space operations or space systems.

Space operations are the backbone of Air Force Space Command and are vital to our nation's war fighting capabilities. This program gives students the chance to directly apply what they learn in the major to an Air Force career. The space operations major provides a solid framework for a future Air Force career whether it is in space or as a pilot. In addition, this major serves as an excellent foundation for graduate studies in such fields as space operations, space systems management, space technology, communications, computer systems, remote sensing, operations research and business administration.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Astro Engr 210	Aero Engr 315	Academy Opt
Chem 200	Astro Engr 331	English 411
Econ 201	Beh Sci 310	Geo 382/History 376
English 211	Biology 315	Mgt 400
Engr Mech 220	Geo 382/History 376	MSS 400
Law 220	History 302	MSS 485
MSS 200	Math 356	Philos 310
Ops Rsch 310	MSS 365	Pol Sci 465
Physics 215	Pol Sci 211	Soc Sci 412
Physics 370	Space 473	Space Ops 461
Space 350/461	Space Ops 360	Space Ops 462
Space Ops Specialty 1	Sys Engr 310	Space Ops Specialty 2

SPACE OPERATIONS (Space Ops)
Offered by the Department of Astronautics (DFAS).

Space Ops 360. Space Mission Operations Fundamentals. Introduces the principles and problems of space operations. Examines elements of space operations including operations management, planning, architecture and execution. Explores orbital mechanics to include the topics of orbit determination and prediction, orbit maneuvers, perturbations and rendezvous as they apply to space operations. Also explores ground station hardware, software and space communication principles.

Space Ops 461. Space Mission Operations I. A second course in space operations. Discusses advanced topics in space operations are discussed, such as satellite pass prediction, planning and execution. Students interface with engineers and program managers in Small Spacecraft Engineering I (Astro Engr 436) to develop mission operations concepts and plans for current and future FalconSAT missions. Students maintain and operate ground equipment in support of on-going satellite operations. At the conclusion of this course, the student will be fully qualified to train future students in any of the three positions—ground station operator, satellite operator or crew commander.

Space Ops 462. Space Missions Operations II. A third course in space operations. Discusses advanced topics in space operations such as ground station design and placement, ground support equipment design and satellite communication subsystem design. Students interface with engineers and program managers in Small Spacecraft Engineering II (Astro Engr 437) and with operators at Schriever AFB, Colorado, to fully develop their understanding of mission operations concepts and plans for current and future FalconSAT missions. Students serve as trainers and mentors for other students enrolled in Space Ops 360. Students also execute mission support for any active FalconSAT mission.

systems engineering major

Systems engineering, an ABET accredited, interdisciplinary major administered by the Director, Systems Engineering (Engineering Division). It is supported by the Systems Engineering Working Group (SEWG) and the Departments of Aeronautical Engineering, Astronautical Engineering, Behavioral Sciences and Leadership, Computer Science, and Electrical and Computer Engineering with participation by the Department of Management. It is a broad discipline addressing the engineering of large, complex systems and integration of the many subsystems that comprise the larger system. All of these various components must function together effectively and efficiently to carry out the mission. Systems engineers are "big picture" engineers who design, integrate and ensure smooth functioning of complex systems typical in today's high-tech Air Force. They keep their eye on the design of the overall system ensuring it will meet the needs of all the system's stakeholders including operators, maintainers and commanders, and even our ultimate customer – the American public!

Systems engineers consider elements of system development, verification, manufacturing, deployment, training, operations, support and disposal. The entire life cycle of the system is considered in a holistic fashion early in the development cycle. Systems engineers accomplish this difficult job, by having broad interdisciplinary knowledge across many areas of study.

The Academy's system engineering program emphasizes a systems-of-systems approach integrating a rigorous engineering curriculum augmented with studies in human systems, operations research analysis, program management and the core curriculum. Students learn that this process is an interdisciplinary one which evolves, verifies and documents an integrated, life-cycle-balanced set of solutions that satisfy customer needs. Students specialize in one of eight defined option areas such as: aeronautical, computer, control, electronic design, human, information, mechanical and space systems.

Students successfully completing the systems engineering major are awarded a Bachelor of Science in systems engineering.

The goal of the systems engineering program is to prepare cadets to become leaders of character who:

- Possess breadth of integrated, fundamental knowledge in the basic sciences, engineering, the humanities and social sciences; and depth of knowledge in the selected option sequence.
- Can communicate effectively.
- Can work effectively with others.
- Are independent thinkers and learners.
- Can apply their knowledge and skills to solve Air Force engineering problems, both well- and ill-defined.
- Know and practice their ethical and professional responsibilities as embodied in the Air Force Core Values.

Upon completion of the systems engineering program each graduate shall demonstrate satisfactory:

- Application of the fundamental concepts of mathematics, science and engineering to solve systems engineering problems.
- Ability to design and conduct experiments and tests, as well as to collect, analyze and interpret data.
- Ability to design a system, component or process to meet desired needs within realistic constraints while balancing costs, schedule, performance and risk factors.
- Ability to function effectively on multi-disciplinary teams.
- A depth of knowledge and skills in systems engineering and a breadth of knowledge and skills in other disciplines to effectively identify, formulate and solve complex systems engineering problems.
- Understanding of professional and ethical responsibilities of military officers and systems engineers.
- Ability to communicate effectively.
- A broad education necessary to understand the impact of engineering solutions in a global economic, environmental, military and social context.
- An appreciation for and the skills required to engage in independent, life-long learning.
- Knowledge of contemporary issues and the role of military officers in our global society.
- An ability to apply modern systems engineering techniques, skills and tools to solve systems engineering problems.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Acad Opt Comp Sci 211	Aero Engr 315	Astro Engr 410
Chem 200	Beh Sci 310	Beh Sci 373
Econ 201	Biology 315	English 411
English 211	ECE 231	MSS 400
Engr Mech 220	History 302	Philos 310
Law 220	Math 356	Soc Sci 412
Math 243	Ops Rsch 321	Sys Engr Capstone 1
Math 245	Sys Engr 301	Sys Engr Capstone 2
MSS 200	Sys Engr 310	Sys Engr Conc 4
Physics 215	Sys Engr Conc 2	Sys Engr Conc 5
Pol Sci 211	Sys Engr Conc 3	Sys Engr Conc 6
Sys Engr Conc 1	Sys Opt Ops Rsch 310	Sys Engr Conc 7

SYSTEMS ENGINEERING (Sys Engr)
Administered by the Departments of Aeronautical Engineering (DFAS), Astronautical Engineering (DFAN), Behavioral Sciences (DFBL), and Electrical and Computer Engineering (DFEC) with participation by the Department of Management (DFM).

Sys Engr 301. Project Management. Introductory project management course. Topics covered include financial project selection models, risk management, project life cycle management, negotiation and meeting management, scheduling, planning, budgeting and project control. Many of these skills are enhanced through the use of MicroSoft Project software.

Sys Engr 310. Introduction to Systems Engineering. Introduction to the systems engineering process and the development lifecycle as a foundation for solving complex problems to fulfill end user needs. Focuses on the systems engineering lifecycle process that includes design, concurrent engineering, software engineering and the concepts of reliability, maintainability and availability. Presents skills and tools that are foundational in the development of interdisciplinary systems engineers. In parallel with the course material, a semester-long system development project facilitates application of systems engineering principles.

Sys Engr 373. Introduction to Human Factors Engineering. Examines the process, principles and guidelines of human factors engineering as they impact the design of systems used by people. Provides an introduction to human factors engineering and systems design. Emphasizes interactions between human capabilities and limitations, to the task, and the environment, as they relate to system performance.

Sys Engr 405. Systems Engineering Seminar I. Seminar course to help integrate Sys Engr and Sys Engr Mgt (SE/SEM) majors into the capstone design sequence and share knowledge across various capstone design projects. Seminar also helps transition SE/SEM majors from undergraduate education to duties as Air Force officers and systems engineering professionals. Topics include current SE/SEM literature and tools used to manage large complex systems and integrate the many subsystems comprising the larger systems, engineering ethics and typical engineering/management problems which students may encounter during their capstone design experience and after graduation. Invited speakers offer their view of what it takes to be successful in the Air Force.

Sys Engr 406. Systems Engineering Seminar II. Seminar designed to help integrate Sys Engr and Sys Engr Mgt (SE/SEM) majors into the capstone design course sequence and share knowledge across various capstone design projects. Seminar also helps transition SE/SEM majors from undergraduate education to duties as Air Force officers and systems engineering professionals. Topics include current SE/SEM literature and tools to manage large complex systems and integrate the many subsystems comprising the larger systems, engineering ethics and typical engineering/management problems which students may encounter during capstone and after graduation. Invited speakers offer their view of what it takes to be successful in the Air Force.

Sys Engr 460. Unmanned Aerial Vehicle (UAV) Systems. Introduction to unmanned aerial vehicle (UAV) systems and systems engineering processes used to build them. Topics include air vehicles and capabilities, ground control stations, payloads, personnel training and support systems. Students work on interdisciplinary teams to build, fly and test one or more UAV systems.

Sys Engr 470. Human Systems Integration. Examines how Human Systems Integration (HSI) plays a critical role in the design, production and implementation of military systems. Although certain systems are designed for uses that may be unique to a particular armed forces organization, the principles and applications discussed are (as far as possible) generic and can therefore be applied to almost any weapons system design program. Also examined are HSI as a systems engineering (SE) discipline and why HSI must be a core component of systems engineering. Students review the major HSI-related areas of concern (domains) that should be assessed when designing, producing and implementing a system.

Sys Engr 491. Systems Engineering Capstone Design I. Capstone design experience for Sys Engr and Sys Engr Mgt (SE/SEM) majors. Emphasizes execution of the systems engineering process over the entire development lifecycle of a complex system. Generally, students will fulfill the SE/SEM roles on existing capstone design projects in various departments. Students apply the systems engineering tools acquired in their previous SE/SEM coursework.

Sys Engr 492. Systems Engineering Capstone Design II. Continuation of Sys Engr 491.

Sys Engr 495. Special Topics in Systems Engineering. Selected topics in systems engineering.

Sys Engr 499. Independent Study. Individual study, research or design supervised by a faculty member. Topic established with the permission of the department head.

systems engineering management major

Systems engineering management, an interdisciplinary major administered by the Department of Management with participation by the Departments of Aeronautical and Astronautical Engineering, Behavioral Sciences, Civil Engineering, Computer Science, and Electrical and Computer Engineering is a broad discipline addressing the engineering management of large, complex systems and integration of the many subsystems comprising the larger system. All these components must function together effectively and efficiently to carry out the mission. System engineering managers are "big picture" engineers who design, integrate and ensure smooth functioning of complex systems typical in today's high-tech Air Force. They keep their eyes on the design of the overall system ensuring it meets the needs of all the system's stakeholders, including operators, maintainers, commanders and even our ultimate customer – the American public!

System engineering managers consider elements of system development, verification, manufacturing, deployment, training, operations, support and disposal. The entire life cycle of the system is considered in a holistic fashion early in the development cycle. Systems engineers managers accomplish this difficult job, by having broad interdisciplinary knowledge across many areas of study.

The Academy's system engineering management program emphasizes a systems-of-systems approach integrating a rigorous engineering and management curriculum augmented with studies in human systems, operations research analysis, program management and the core curriculum. Students learn that this process is an interdisciplinary one which evolves, verifies and documents an integrated, life-cycle-balanced set of system solutions that satisfy customer needs.

Cadets successfully completing the systems engineering management major are awarded a Bachelor of Science in systems engineering management.

The goal of the systems engineering management program is to prepare students to become leaders of character who:

- Possess breadth of integrated, fundamental knowledge in the basic sciences, engineering, humanities and social sciences; and depth of knowledge in systems engineering management.
- Can communicate effectively.
- Can work effectively with others.
- Are independent thinkers and learners.
- Can apply their knowledge and skills to solve Air Force engineering and management problems, both well- and ill-defined.
- Know and practice their ethical and professional responsibilities as embodied in the Air Force core values.

Upon completion of the systems engineering management program each graduate shall demonstrate satisfactory:

- Application of the fundamental concepts of systems engineering to solve systems engineering problems.
- Breadth of knowledge and analysis skills in systems engineering, engineering design, test, human systems, information systems, operations research, management and other related disciplines; depth of knowledge in management.
- Synthesis and integration of the above knowledge to effectively identify and solve the types of complex, multidisciplinary problems encountered as Air Force systems engineering managers.
- Balancing cost, schedule, performance and risk factors in decision making.
- Laboratory techniques including procedures, recording and analysis.
- Design, fabrication and testing techniques.
- Written and oral communication skills.
- Knowledge of ethical and professional responsibilities.
- Knowledge of the benefits and the skills needed to engage in life-long learning.
- Ability to be effective multidisciplinary team members.
- Skills to be an independent learner while knowing when to seek assistance.
- Knowledge of the role of Air Force engineering and management officers in our global society.
- Knowledge of contemporary social, political, military and engineering issues.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Chem 200	Aero Engr 315	Academy Opt
Econ 201	Beh Sci 310	Astro Engr 410
ECE 231/315	Biology 315	Beh Sci 373
English 211	Depth Opt	English 411
Engr Mech 220	History 302	Mgt 400
Law 220	Math 356	Mgt 437
Math/Comp Sci Opt	Mgt 303	Mgt 477
MSS 200	Mgt 342	MSS 400
Physics 215	Mgt 345	Philos 310
Pol Sci 211	Sys Engr 301	Soc Sci 412
Sys Engr 310	Sys Engr Mgt Opt 1	Sys Engr 491
Sys Opt Ops Rsch 310	Sys Engr Mgt Opt 2	Sys Engr 492

SYSTEMS ENGINEERING MANAGEMENT (Sys Engr Mgt)
Administered by the Departments of Aeronautical Engineering (DFAS), Astronautical Engineering (DFAN), Behavioral Sciences (DFBL), Computer Sciences, and Electrical and Computer Engineering (DFEC), with participation by the Department of Management (DFM).

Sys Engr Mgt 495. Special Topics in Systems Engineering Management. Selected topics in systems engineering management.

All other applicable systems engineering management course descriptions may be found under the systems engineering major course descriptions.

bachelor of science program

The Bachelor of Science Program is not a major. The Bachelor of Science Program (BSP) provides a broad educational foundation for graduation and subsequent service as a professional Air Force officer, without specialization in a particular academic discipline. The BSP provides for maximum flexibility in selecting advanced courses for depth and/or breadth beyond core requirements. Successful completion of this program results in a Bachelor of Science degree. The BSP can only be declared through DFR or ARC Chair recommendation, with DFV approval, no earlier than a student's third semester. The Office of Student Academic Affairs administers the BSP.

Suggested Course Sequence

3rd-Class Year	2nd-Class Year	1st-Class Year
Academic Div Opt	Academic Div Opt	Acad Div/Open Opt
Academic Div Opt	Academic Div Opt	Academic Div Opt
Academic Div Opt	Aero Engr 315	Academic Div Opt
Chem 200	Beh Sci 310	Academic Div Opt
Econ 201	Biology 315	Academy Opt
English 211	ECE 315	Astro Engr 410
Engr Mech 220	History 302	English 411
Law 220	Math 300/356/378	Mgt 400
MSS 200	Philos 310	MSS 400
Physics 215	S/T Energy Sys Opt	Soc Sci 412
Pol Sci 211		