CURRICULUM HANDBOOK

This Handbook Contains General Information Concerning Graduation Requirements, Academic Registration Procedures, Course Offerings, and Academic Programs Effective Fall 2005 at the United States Air Force Academy.

As directed in USAFA Instruction 36-3507, the Office of the Dean of the Faculty publishes this handbook annually. Procedures for initiating changes to this handbook are contained in USAFA Instruction 36-3507. The Curriculum Handbook documents the curriculum of the United States Air Force Academy, as approved by the Academy Board.

This handbook contains information relating to the academic year 2005-2006. Every effort has been made to ensure its accuracy, but USAFA reserves the right to make corrections and changes in any information contained in this and subsequent issues of the Curriculum Handbook or in any of its other publications. Courses of instruction, programs, degree requirements, and any other matters are subject to change.

Information concerning this handbook and additional copies may be obtained from the Curriculum Division, Office of the Registrar (DFRC), 2354 Fairchild Drive, Suite 2G13, USAF Academy, Colorado, 80840. The Curriculum Handbook is also available on-line at http://orion.usafa.af.mil/dfr/dfrc.htm. This handbook was edited by Major Hal Taylor, DFRC, 719-333-2106.

UNITED STATES AIR FORCE ACADEMY
CURRICULUM HANDBOOK
2005-2006
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SECTION I

CHAPTER 1

INTRODUCTION

1-1. PURPOSE OF THE CURRICULUM HANDBOOK. The Office of the Registrar (DFR), Academic Affairs Division (DFRC), publishes the Curriculum Handbook at the beginning of each academic year. Together with the USAFA Catalog, published by the Office of Admissions (RR), it documents the curriculum of the United States Air Force Academy as approved by the Academy Board. The Curriculum Handbook contains general information concerning graduation requirements, academic registration procedures, course offerings, academic programs and majors, and academic probation. If you have questions, contact DFRC in Fairchild Hall, Room 2G13, (719) 333-2106.

1-2. HANDBOOK CONTENTS. This handbook is organized into three main topic areas. Chapters 1-6, General Information, contain information concerning academic registration procedures, grades, scheduling, academic deficiencies, and special programs. Chapters 7-10, Academic Programs, deal with the core courses and academic minors and majors. Chapters 11 and 12 contain definitions and course descriptions.

1-3. CURRICULUM CHANGE PROPOSALS. The Academy has established procedures for updating and revising the USAF Academy curriculum. These procedures are explained in detail in USAFA Instruction 36-3507, Curriculum Handbook and Curriculum Change Control.

1-4. OBJECTIVES OF THE ACADEMY CURRICULUM.

a. Officer Development System

(1) USAFA's Officer Development System (ODS) is founded on the idea that professional commitments can be fostered through deliberate connections to the principles of professional military service. ODS provides a holistic framework designed to coordinate and integrate cadet developmental activities across their entire four-year experience with emphasis on cadet ownership. Above all else, it focuses on character-based officership and prepares cadets for a career of continual professional development in service to the Air Force and the nation.

(2) The threefold purpose of ODS is to develop each cadet's appreciation that being an officer is a noble way of life, to foster a commitment to character-based officership, and to develop competencies essential to this identity as a character-based officer-leader.

(3) The academic, cadet professional military education, physical education, and character development programs work together to support USAFA's ODS goals.

b. Academic Program.

(1) Provides cadets with general courses in the basic sciences, engineering, social sciences, and humanities to form a foundation for their development as future Air Force officers.

(2) Offers elective courses to meet cadets' needs.

(3) Motivates cadets toward advanced education through enrichment courses (e.g., advanced placement, audit, special topics, and independent study).

(4) Prepares cadets to fulfill their intellectual responsibilities as citizens and dedicated public servants in the Air Force.

c. Cadet Professional Military Education (CPME).

(1) Develops the moral character and leadership qualities desired of an Air Force officer.

(2) Instills dedication to national defense and pride in the Air Force.

(3) Prepares cadets to perform the duties of an officer, to pursue continued professional development through military education programs, and to demonstrate competence in those fields unique to military service, particularly the United States Air Force.

d. Physical Education and Athletics.

(1) Develops desirable traits of character essential to leadership, including persistence, desire to win, aggressiveness, and esprit de corps.

(2) Teaches skills needed to perform physical tasks.

(3) Encourages a positive attitude toward physical fitness.

e. Character Development

(1) Facilitates character development throughout all aspects of the Academy experience.

(2) Prepares graduate officers who:

(a) Have forthright integrity and voluntarily decide to do the right thing.

(b) Are selfless in service to the country, the Air Force, and their subordinates.

(c) Are committed to excellence in the performance of their personal and professional responsibilities.

(d) Respect the dignity of all human beings.

(e) Are decisive, even when facing high risk.

(f) Take full responsibility for their decisions.

(g) Have the self-discipline, stamina, and courage to do their duty well even under the extreme and prolonged conditions of national defense.

(h) Appreciate the significance of spiritual values and beliefs to their own character development and that of the community.

1-5. GRADUATION AND RESIDENCY REQUIREMENTS. To graduate from the USAF Academy, a cadet must demonstrate an aptitude for commissioned service and leadership, display acceptable conduct, maintain proficiency in physical education and the professional development program, and meet all requirements for an academic major.

a. To fulfill academic requirements, cadets must satisfactorily complete the core curriculum and an academic major. Cadets must meet minimum standards of a 2.00 cumulative grade point average (GPA), a 2.00 GPA in the core curriculum, and a 2.00 major's GPA.

b. A cadet must have at least eight semesters in residence at USAFA. A semester spent in a USAFA-sponsored exchange program counts as a semester in residence. A cadet must take at least 132 semester hours at USAFA (including those completed in USAFA-sponsored exchange programs) to satisfy residency requirements, regardless of semester hours transferred and validated. Courses which do not fulfill residency requirements include those validated or transferred, courses carrying no semester hour credit, pass/fail courses unless designated as an Academy Option, failed courses, and courses taught by Student Academic Services (Study Skills and Reading Skills).

c. A cadet's professional development program includes a course of study in professional military education and the leadership laboratory experience provided by being part of the Cadet Wing. Each cadet is evaluated on military performance each semester and must maintain a minimum level of performance. Before graduation, each cadet must successfully complete each of the Core Military Training programs as a student. Each Cadet must successfully complete two leadership programs, one of which must be a Military Leadership program. Leadership credit can be obtained during the school year if key leadership positions within the Cadet Wing are held for the entire semester. 34th TRS is the OPR for this program IAW AFCWI 36-3010.

d. To fulfill the Physical Education requirements, cadets take 5.0 semester hours (ten 0.5 semester hour courses) of Phy Ed credit over their four academic years. Participation in intramurals, clubs, or intercollegiate athletics is required in each of their eight academic semesters. Proficiency is also required in both the physical fitness test (PFT) and aerobic fitness test (AFT). Athletic proficiency for graduation is demonstrated by meeting the minimum standard of a 2.00 cumulative physical education average (PEA). PEA is a

weighted 4.00 grading scale (50% PFT + 35% PE courses + 15% AFT).

e. To fulfill character development requirements, cadets must satisfactorily complete the following four programs administered by the Center for Character Development (34 TRW/CWC):

1°: ACES (Academy Character Enrichment Seminar)
2°: LIFT (Leaders in Flight Today)
3°: R & R (Respect and Responsibility)
4°: VECTOR! (Vital Effective Character Through Observation and Reflection)

f. Transfer/validation credit. Cadets who attended another college or university or who validate courses may earn validation or transfer credit that is included in the total semester-hour count. If cadets leave the Academy prior to Lesson 9 of their first semester, transfer/validation credit will not appear on their USAFA transcripts. A cadet who is readmitted following disenrollment or resignation may be given transfer credit for courses taken while away from USAFA. If the transfer credit is for a course previously taken at USAFA and subsequently repeated at another college or university, the transfer credit should fill the core requirement on the grad check and the previous grade will be listed under "other courses taken."

1-6. INTERNATIONAL CADETS. Students from foreign countries are designated International Cadets. International Cadets for whom English is a second language are awarded validation credit for their native language. They must fulfill all other Academy graduation requirements to earn a Bachelor of Science degree; those International Cadets who do not fulfill all requirements before graduation are awarded a certificate of completion stating they attended the USAF Academy for four years. For details, refer to Faculty Operating Instruction 36-164, Policies and Procedures for Cadets Who Speak English as a Second Language.

CHAPTER 2

REGISTRATION

2-1. RESPONSIBILITY FOR REGISTRATION.

a. Cadet Responsibilities. The primary responsibility for completion of graduation requirements rests with the cadet. Each cadet is expected to plan a course of study and maintain satisfactory standards of scholarship and conduct. The faculty stands ready to help when called upon, **but the initiative rests with the cadet**. **Cadets must meet with their academic advisors or Associate Air Officers Commanding for Academics (AAOCA) at least once each semester prior to the registration deadline for the following semester.** In addition, cadets will take the following steps:

(1) Deliver all annotated Academic Program Summaries (APSs) with course changes for the following semester to DFRC if after the registration deadline.

(2) Verify the accuracy of each document returned from the Office of the Registrar following the processing of course change requests.

(3) Ensure that the latest copy of the APS accurately reflects plans for meeting graduation requirements.

(4) See their AAOCAs to declare academic majors. Cadets must declare a major no later than the registration deadline during their third semester (fall of third-class year). However, some majors, Computer Science for example, should be declared before the end of the fourth-class year.

(5) Submit a USAFA Form 0-498, Request for Permission to Enroll in an Independent Study Course, when necessary (see para 2-10).

(6) Comply with all registration changes, academic major declarations, and academic major change procedures and deadlines described in this handbook.

(7) When appropriate, submit a letter of request for a second academic major to Office of the Registrar Customer Service not later than lesson 5 of the fall semester of the first-class year.

b. Advisor-in-Charge (AIC), Academic Advisor, and AAOCA responsibilities

(1) Fill out or review advising worksheet at initial meeting with each advisee at the beginning of each fall semester.

(2) Hold cadets accountable for meeting deadlines established in this handbook. To ensure accomplishment of all necessary administrative requirements, advisors and

AAOCAs must meet with their advisees at least once each semester prior to the registration deadline for the following semester.

(3) Be available for cadet appointments concerning registration changes, academic program declarations, and academic program changes.

(4) Coordinate all advisee registration changes, academic program declarations, and academic program changes by completing the online Q2 registration process.

(5) Verify each advisee's program meets course prerequisite requirements and that waivers and department permission have been obtained as required.

(6) Be responsible for accomplishing counseling, registration changes, or academic program changes with advisees directed by the Academic Review Committee (ARC).

(7) Initiate, at the beginning of the semester, an annotated APS to drop all overload courses for cadets who do not meet minimum GPA criteria for overloads.

(8) Make sure each advisee's academic program includes all requirements for graduation.

(9) Ensure cadets on academic probation are counseled at each progress report.

(10) Assist and counsel advisees preparing for ARC interviews.

(11) Provide mentoring and guidance towards achievement of the cadets' personal and professional goals.

2-2. ACADEMIC COUNSELING AND ADVISING. The Dean of the Faculty has given DFR responsibility for administering the academic advising and counseling program. DFRC trains and educates the AAOCAs and AICs for each academic program the Academy offers.

a. AAOCA. Each AAOCA provides general advice and counsel on academic programs to cadets of his/her squadron. The AAOCA serves as the academic advisor for cadets in one squadron who have not yet selected an academic major. AAOCAs mentor cadets in selecting an academic program that mirrors the cadets life goals and is supported by the cadet's abilities. AAOCAs keep records on all advisees. A more detailed listing of the functions and responsibilities of AAOCAs is contained in the Mentoring and Advising Handbook.

b. Advisor-in-Charge (AIC). Each AIC is responsible for the advising of all cadets within the applicable academic program. The AIC may have a number of assistants (advisors) to help counsel cadets interested in that discipline; however, it is the AIC who makes all final decisions in administering the program. The AIC, in general, oversees the proper completion and timely submission of all inputs to the registration system. In this regard, the AIC serves as the single point of control for all paperwork and procedures concerning the program; DFRC will honor only the AIC's signature or that of a designated alternate.

APS / Grad Check

Personal Data - Privacy Act of 1974

DFRI - Q2i System Snapshot Date: 21 Jul 2005 22:47

Grad Check As Of: 7/21/2005 11:46:10 AM

SSAN: **Class Year:** 2007 **Squadron:** **Aca Comp:** 3272 **Advisor:**

Cum GPA: 3.05 **Core GPA:** 2.97 **1st Major GPA:** 3.23

Summer 2003

MilTng	100	0.0(		P
PhyEd	100	0.0(		P
		0.0(		

Fall 2003

CompSci	110	3.00	B	A
Engr	100	3.00	A	B
Math	152	3.00	B	B
MSS	100	3.00	C	C
PDP	100	0.00		
PhyEd	112B	0.50		B-
SocSci	112FR	3.00	B	B
		15.50		

GPA		MPA		PEA	
2.99	2.99	2.700	2.700	2.35	2.35

Honors: **Dean's**

Spring 2004

BehSci	110	3.00	C-	C+
CompSci	211	3.00	A	A
English	211FR	3.00	B-	B-
EngrMech	120	3.00	A	B
History	101	3.00	C+	B-
Math	243	3.00	B	B+
PDP	101	0.00		
PhyEd	114E	0.50		B-
		18.50		

GPA		MPA		PEA	
2.99	2.99	2.800	2.750	2.05	2.20

Honors: **Dean's**

Summer 2004

MilTng	220GI	0.00		P
MilTng	260EF	0.00		P
MilTng	444AC	0.00		
MilTng	444DE	0.00		
		0.00		

GPA
2.99

Fall 2004

AstroEngr	310	3.00	B	B+
Biology	215	3.00	B	B+
Econ	200	2.00	B	B-
Law	220	3.00	B-	C+
Math	245	3.00	C	B
PDP	200	0.00		
PhyEd	488A	0.50		B-
Physics	215	3.00	C	B
		17.50		

GPA		MPA		PEA	
2.94	2.97	2.940	2.813	1.25	1.88

Spring 2005

AeroEngr	241	3.00	C	B
AstroEngr	201	1.00	P	P
CivEngr	210	3.00	B-	A-
History	202	3.00	C+	B
Math	346	3.00	C+	B+
Mgt	200	2.00	A-	A
PDP	201	0.00		
PhyEd	111F	0.50		B
PhyEd	222G	0.50		C+
		16.00		

GPA		MPA		PEA	
3.31	3.05	2.990	2.857	2.52	2.35

Honors: **Dean's**

Summer 2005

MilTng	201AC	0.00		P
MilTng	315DF	0.00		P
MilTng	444GI	0.00		
		0.00		

GPA	MPA	
3.05	3.000	2.886

Fall 2005

AeroEngr	315	3.00		
AstroEngr	351	3.00		
ElEngr	231	3.00		
Engr	341	3.00		
EngrMech	320	3.00		
PDP	300	0.00		
PhyEd	215C	0.50		
PhyEd	315D	0.50		
		16.00		

Spring 2006

AstroEngr	321	3.00		
AstroEngr	331	3.00		
BehSci	310	3.00		
Engr	342	3.00		
Math	356	3.00		
PDP	301	0.00		
Philos	310	3.00		
PhyEd	340F	0.50		
		18.50		

Fall 2006

Armnshp	425	3.00		P
AstroEngr	423	3.00		
AstroEngr	452	4.00		
ElEngr	447	3.00		
EngrMech	330	3.00		
PDP	400	0.00		
PhyEd	486D	0.50		
PolSci	311	3.00		
		19.50		

Spring 2007

Armnshp	490F	0.00		
AstroEngr	445	3.00		
AstroEngr	453	4.00		
Biology	350	3.00		
English	411	3.00		
MSS	400	3.00		
PDP	401	0.00		
PhyEd	483F	0.50		
		16.50		

Major(s)	Minor(s)
AstroEngr	No Minor

Transfer Credit

Chem	141	2003A
Chem	142	2003A
English	111	2003A

Validation Credit

Math	141	2003A
Physics	110	2003A

Probation	Start	End
ATH	2004-10-09	2004-12-21
ATH	2004-12-23	2005-03-09

Medical Status

Entry	Other	Grad
CQ		

Cadet: _____

Advisor: _____

AIC: _____

Personal Data - Privacy Act of 1974

Figure 2-1

APS / Grad Check

Personal Data - Privacy Act of 1974

DFRI - Q2i System Snapshot Date: 21 Jul 2005 22:47

Grad Check As Of: 7/21/2005 11:46:10 AM

SSAN: **Class Year:** 2007 **Squadron:** **Aca Comp:** 3272 **Advisor:**

Cum GPA: 3.05 **Core GPA:** 2.97 **1st Major GPA:** 3.23

Core

Requirement	Course	GPA	Wvr	Sem	Grd	Hrs
C01AB - AeroEngr 315	AeroEngr	315 C		05B	*	3.0
C02BA - Energy/Systems	AeroEngr	241 C		04C	B	3.0
C03AC - Astro 310	AstroEngr	310 C M1		04B	B+	3.0
C04AB - Chem Core	Chem	141		03A	T	3.0
C04AB - Chem Core	Chem	142		03A	T	3.0
C05AB - Comp Sci 110	CompSci	110 C		03B	A	3.0
C06AC - Econ 200	Econ	200 C		04B	B-	2.0
C07AB - Engr 100	Engr	100 C		03B	B	3.0
C08AE - Civ Engr 210	CivEngr	210 C		04C	A-	3.0
C09AA - El Engr 215/231	ElEngr	231 C		05B	*	3.0
C10AC - English 111	English	111		03A	T	3.0
C11BA - English 211	English	211 C		03C	B-	3.0
C12AA - English 411	English	411 C		06C	*	3.0
C15AB - Beh Sci 310	BehSci	310 C		05C	*	3.0
C16AA - History 101	History	101 C		03C	B-	3.0
C17AA - History 202	History	202 C		04C	B	3.0
C20AB - Law 220	Law	220 C		04B	C+	3.0
C21AB - Biology 215	Biology	215 C		04B	B+	3.0
C22AB - Math 141	Math	141		03A	V	3.0
C23AB - Math 142/152	Math	152 C		03B	B	3.0
C26BA - Math 300	Math	356 C		05C	*	3.0
C28AC - Physics 110	Physics	110		03A	V	3.0
C29AB - EngrMech 120	EngrMech	120 C		03C	B	3.0
C30AA - Philos 310	Philos	310 C		05C	*	3.0
C31AB - Physics 215	Physics	215 C		04B	B	3.0
C33AB - Pol Sci 211/311	PolSci	311 C		06B	*	3.0
C34AC - Soc Sci 112	SocSci	112 C		03B	B	3.0
C37AB - Beh Sci 110	BehSci	110 C		03C	C+	3.0
C40BA - Mgt 200	Mgt	200 C		04C	A	2.0
C54BC - MSS 100	MSS	100 C		03B	C	3.0
C58BB - MSS 400	MSS	400 C		06C	*	3.0
C91AA - Combative	PhyEd	114 C		03C	B-	0.5
C91AB - Physical Devel	PhyEd	112 C		03B	B-	0.5
C92AA - Swimming	PhyEd	111 C		04C	B	0.5
C92AB - Water Survival	PhyEd	222 C		04C	C+	0.5
C92AC - Indiv Sport Opt	PhyEd	340 C		05C	*	0.5
C93AA - Unarmed Combat1	PhyEd	215 C		05B	*	0.5
C93AB - Unarmed Combat2	PhyEd	315 C		05B	*	0.5
C93AC - Team Sport Opt	PhyEd	486 C		06B	*	0.5
C94AA - Open Elective	PhyEd	483 C		06C	*	0.5
C94AB - Open Elective	PhyEd	488 C		04B	B-	0.5

Major: 1st (AstroEngr)

Requirement	Course	GPA	Wvr	Sem	Grd	Hrs
M33BB - Math 243	243					
M33CB - Math 245	245					
M33DA - Math 346	346					
M33EB - Emech320/Phy355	320					
M33FB - Space Envr Opt	350					
M33GB - El Engr 447	447					
M33HA - Engr 341	341	M1				
M33IA - Engr 342	342	M1				
M33JC - Astro 321	321	M1				
M33KB - Astro 331	331	M1				
M33LB - Astro 351	351	M1				
M33MB - EngrMech 330	330	M1				
M33NB - Astro 445	445	M1				
M33OB - Astro201/CS211	201					
M33PB - Applied Astro	452	M1				
M33PB - Applied Astro	453	M1				
M33QB - Depth Option	423	M1				
M33RB - Academy Option	211					

Other Courses Taken

Course	GPA	Wvr	Sem	Grd	Hrs
Armnshp	425		06B	P	3.0
Armnshp	490		06C	P	0.0
MilTng	100		03A	P	0.0
MilTng	201		05A	P	0.0
MilTng	220		04A	P	0.0
MilTng	260		04A	P	0.0
MilTng	315		05A	P	0.0
PDP	100		03B		0.0
PDP	101		03C		0.0
PDP	200		04B		0.0
PDP	201		04C		0.0
PDP	300		05B		0.0
PDP	301		05C		0.0
PDP	400		06B		0.0
PDP	401		06C		0.0
PhyEd	100		03A	P	0.0

Resident Semester Hours - 135 Resident Semester Hours Required for Graduation - 132 Total Semester Hours - 153

--- = Missing Requirement * = Midterm Grade Wvr: Y = Waiver Granted GPA: C = Core; M1 = 1st Major; M2 = 2nd Major Sem: YY=Academic Year; A=Summer; B=Fall; C=Spring

Personal Data - Privacy Act of 1974

Figure 2-2

c. Maintenance of Cadet Academic Records. The AIC, advisor, or AAOCA keeps a current copy of cadets' APSs and other academic-related documents to include waivers, graduation checks, Cadet Academic Deficiency Evaluation and Probation Action Plans (USAFA Form 68, Figures 5-1a and b) and special information concerning cadets' academic programs. Cadets should keep copies of all information related to their academic programs. Cadets' official transcripts may be requested from DFRR. The most current APSs are available from the CAMIS II Cadet Schedules application or from Q2.

2-3. PROGRAM PLANNING. During their first semester at the Academy, fourth-class cadets should begin planning their academic program. As an aid to cadets and their AAOCAs, DFRR will pre-register each cadet in all core courses the cadet must complete at the Academy. Cadets and AAOCAs must check APSs for omissions and sequencing errors. Cadets may make changes to this initial schedule, provided they satisfy core sequencing policies.

a. Course Offerings. Course offerings are published annually in the *USAF Academy Catalog*, semi-annually in the Curriculum Handbook Supplement, and annually in this handbook.

b. Contact Hours. The two-day USAF Academy scheduling cycle limits the available number of periods (contact hours) to 14. Because some academic courses meet every day or require a double period for laboratory or seminar meetings, cadets should be careful to keep their programs within the 14-period limit each semester. Cadets should pay particular attention to flying programs that require additional periods. The number of contact hours for each course is shown in the course description section of this handbook beside the course identifier. For example, an entry "3(2)" indicates that a course has three-semester hours value and meets two contact hours over the two-day scheduling cycle.

c. Course Preparation. Academic study loads are based on the expectation that cadets prepare 100 minutes outside of class for every 50 minutes in class. This translates to an expectation of 6-10 hours of study each weekend, full use of free periods, and focused study during Academic Call to Quarters.

d. Course Load. When planning course loads, cadets should attempt to balance their schedules as much as possible. The minimum course load for all cadets is five academic courses. The exception to this is for cadets enrolled in flight screening (see para 6-10). The mimimum course load, for cadets enrolled in both Econ 200 and Mgt 200, is five academic courses and 13.5 semester hours.

(1) The minimum course load for fourth-class cadets in the fall semester is five academic courses (must be a minimum of 14.5 semester hours). The exceptions are mandatory enrollees in the Academically At-Risk Program (see para 6-4); the course loads for their first two semesters are determined upon entry into the Academy. All cadets enrolled in the at-risk program carry four academic courses and Study Skills 101 during the fall semester. If enrolled in both Math 130 and English 110, at-risk fourth-class cadets will carry five academic courses and Study Skills 101.

(2) At-risk fourth-class cadets will be enrolled in five academic courses (must be a minimum of 14.5 semester hours) during the spring semester of the fourth-class year. In addition, these cadets will normally be granted an academic-plus-leave slot in the summer prior to their third-class year. The normal course load for all other fourth-class cadets in the spring semester is six academic courses. Fourth-class cadets cannot overload to seven courses.

(3) Third-class, second-class and first-class cadets must take a minimum of five courses (a minimum of 13.5 semester hours if enrolled in both Mgt 200 and Econ 200, a minimum of 14.5 semester hours if enrolled in one of these courses) and a maximum of 7 academic courses, or 22 semester hours per semester. Cadets who are in good standing may exceed 22 semester hours if they have a minimum 3.25 cumulative or previous semester GPA. Waiver authority is ARC Chair approval (coordinated with 34 TRG and/or AH).

(4) The minimum course load for the Wing Commander, Vice Wing Commander, the four Group Commanders, the Wing Honor Chairman, the Deputy Wing Honor Chairman, and the eight Group Honor Chairmen is 12.5 semester hours.

(5) Any cadet placed on academic probation may be ARC-directed to drop a course or courses.

e. Normal Course Load Progression for Graduation:

CLASS	**SEMESTER**	**SEMESTER HOURS**	
		Divisional	*Disciplinary*
Fourth	1	**15.5**	**15.5**
	2	**18.5**	**18.5**
Third	3	**17.5**	**18.5**
	4	**18**	**20.5**
Second	5	**18.5**	**18.5**
	6	**18.5**	**18.5**
First	7	**18.5**	**19.5**
	8	**16**	**17.5**
Total Semester Hours:		**141**	**147- 148**

2-4. CADET ADMINISTRATIVE MANAGEMENT INFORMATION SYSTEM (CAMIS). CAMIS II is the computer database USAFA personnel use to record cadets' academic programs. Office of the Registrar staff produce and distribute CAMIS II products that cadets and advisors use for registration and monitoring progress towards graduation. Q2 is an administrative tool used to simplify numerous academic administrative functions. If Q2 and CAMIS II products conflict, CAMIS II products take precedence. Samples of the Q2 APS and the Academic Graduation Check are provided in Figures 2-1 and 2-2.

a. Academic Program Summary. Information found on the APS (Figure 2-1) includes

transfer and validation credit, athletic squads, clubs, intramurals, total semester hours for each semester, total cumulative semester hours at the end of each semester, semester and cumulative GPA at the end of each semester, turnback status, academic probation information, and courses taken and planned. The following areas warrant further explanation:

(1) "Academic Probation" indicates academic probation for mid-semester (Prog), end-of-semester (End), or end-of-summer term (End) and is a permanent entry for that semester or term.

(2) The semester hour total listed below each semester's courses reflects all completed graded courses, completed pass/fail courses, and transfer and validation semester hours' credit.

(3) Activity Codes: Following are the activity codes which appear on the APS. The prefix "V" indicates varsity. "J" indicates junior varsity. "I" indicates intramurals. "O" or "C" designate clubs. The suffix "M" indicates male, "F" indicates female and "C" indicates coed. The middle two letters indicate the activities listed in Figure 2-3.

b. Academic Graduation Check. The three major sections of the grad check (Figure 2-2) are Core Requirements, Major Requirements, and Other Courses Taken. Columns represent the following:

(1) The "Requirement" column lists the Master Course File number and the course title.

(2) The "Course" column lists the course filling the requirement.

(3) The "GPA" column lists each GPA toward which that course counts.

(4) The "Wvr" column indicates whether that course was waived (Y) into that requirement.

(5) The "Sem" column lists the semester in which the course was taken or is planned.

(6) The "Grd" column lists the final grade, the mid-term grade, or no grade for a course not yet taken (*) or scheduled (--). A 'T' indicates transfer credit. A 'V' indicates validation credit.

(7) The "Hrs" column lists the semester hours associated with the course filling that requirement.

c. Verification of Graduation Requirements.

(1) Academic Requirements: During the fall semester, DFRC audits the core curriculum portion of each first-class cadet's graduation check to ensure all core requirements have been or will be met. Coordinate with DFRC if you make any changes to the cadet's

program subsequent to this certification to ensure the graduation check remains valid.

(2) Verification of Military Graduation Requirements: Each fall semester, 34 TRG will audit and verify the military training curriculum portion of cadets' graduation check to ensure all military training requirements have been or will be met. Advisors cannot make changes to a cadet's summer military training program. Address questions to 34 TRS/SPR.

(3) Verification of Athletic Graduation Requirements: Each semester, AHP will audit and verify the physical education curriculum portion of each cadet's graduation check to ensure their physical education course requirements and their Physical Education Average (PEA) status fulfills graduation requirements.

d. Semester Titles. Semester and term titles on the APS and grad check print out as follows:

SEMESTER TITLES

Semester/Term	*APS Title*	*AGC Title*
Summer Term 2005	Summer 2005	05A
Fall Semester 2005	Fall 2005	05B
Spring Semester 2006	Spring 2006	05C
Summer Term 2006	Summer 2006	06A

2-5. REGISTRATION PERIODS. Four types of registration periods occur:

a. Special Semester Registration: Changes authorized anytime. Coordination by all affected departments is required. Changes authorized:

(1) Drop courses per course drop timetable (para 2-7d)

(2) First-class only: correct grad check discrepancies (department coordination required)

(3) Department-approved changes to lower/higher-level courses

(4) Academic Review Committee-directed changes

(5) Change of advisor and/or major

b. Late Registration: Registration changes for the next semester requested after that semester's registration deadline (e.g., changes to spring requested in December) are made only in special circumstances. Obtain permission to add or drop classes from each affected department head in the form of a signature on the APS.

c. Future Semester On-Line Registration: Registration changes for future fall and spring semesters are accepted anytime in Q2. If past the registration deadline for that semester, late

registration procedures apply (see paragraph above). Department coordination is required during on-line registration for future semesters if the change violates course prerequisites (para 7-4) or the course requires department permission as directed by the course description (Chapter 11).

d. Summer Registration: Summer registration occurs in the spring semester preceding the summer term. Details will be advertised by DFRC to cadets and advisors. Enrollment in summer courses is on a "first come, first served" basis. APSs registering a cadet in summer academics will only be accepted from the cadet.

Figure 2-3
Activity Codes

Competitive
BY C BICYCLE CLUB
FO C FORENSICS
FP F FASTPITCH SOFTBALL
HB M HANDBALL
JU C JUDO
LX F LACROSSE
PI C PISTOL
RB F RUGBY
RB M RUGBY
SB F SOFTBALL
SN C SKIING
VB M VOLLEYBALL

Intramural
AE C AEROBICS
BB C BASKETBALL
BO C BOWLING
BX M BOXING
CC C CROSS COUNTRY
FE C FOREIGN EXCHANGE
FF C FLAG FOOTBALL
FK C FLICKER BALL
MC C MOUNTAIN CYCLING
OT C OTHER
RB F RUGBY
RB M RUGBY
RC C RECONDITION
RQ C RACQUETBALL
SB C SOFTBALL
SO C SOCCER
TH C TEAM HANDBALL
TN C TENNIS
UF C ULTIMATE FRISBEE
VB C VOLLEYBALL
WA C WALLYBALL
WD C WING DUTY
WP C WATER POLO
WT C WEIGHT TRAINING

Junior Varsity
BA M BASEBALL
BB F BASKETBALL
BB M BASKETBALL
CC F CROSS COUNTRY
CC M CROSS COUNTRY
CL F CHEER LEADER
CL M CHEER LEADER
FB M FOOTBALL
FN F FENCING
FN M FENCING
GO M GOLF
IH M ICE HOCKEY
LX M LACROSSE
RI F RIFLE
RI M RIFLE
SO F SOCCER
SO M SOCCER
SW F SWIMMING
SW M SWIMMING
TN F TENNIS
TN M TENNIS
TR F TRACK
TR M TRACK
VB F VOLLEYBALL
WR M WRESTLING

Mission Support
AA C ARNOLD AIR SOCIETY
CH C CHORALE
DB C DRUM & BUGLE
FA C FALCON HANDLER
FO C FORENSICS
FV C EMER MED TECHS
FY C FLYING
HG C HONOR GUARD
LS C FIRST RESPONDERS
MA C MEDIA
PP C POLARIS
PT C SANHURST TEAM
SD C SABRE DRILL TEAM
SG C SOARING

Recreational
AK C AIKIDO REC CLUB
AR C ARCHERY
BS C BIG BROTHERS/SISTERS
EC C PRIOR ENLIST. COUNCIL
EQ C EQUESTRIAN
FL C FITNESS/POWERLIFTING
HU C HUNTING
IS C ICE SKATING
JU C JUDO
KA C KARATE
KR C KARATE/TECHNICAL
KT C KARATE/TEAM
LP C LOS PADRINOS
ME C MODEL ENGINEERING
MT C MOUNTAINEERING
NJ C NINJITSU
PD C PAINTBALL
PR C PACIFIC RIM
RD C RODEO
RG C ROWING
SA C SCUBA
SN C SKIING
SQ C SQUASH
TS C TRAP/SKEET
WG C WARGAMING
WL C WAY OF LIFE

Varsity
BA M BASEBALL
BB F BASKETBALL
BB M BASKETBALL
BS M BOXING
CC F CROSS COUNTRY
CC M CROSS COUNTRY
CL F CHEER LEADER
CL M CHEER LEADER
DV F DIVING
DV M DIVING
FB M FOOTBALL
FN F FENCING
FN M FENCING
GO M GOLF
GY F GYMNASTICS
GY M GYMNASTICS
IH M ICE HOCKEY
LX M LACROSSE
RI F RIFLE
RI M RIFLE
SO F SOCCER
SO M SOCCER
SW F SWIMMING
SW M SWIMMING
TN F TENNIS
TN M TENNIS
TR F TRACK
TR M TRACK
VB F VOLLEYBALL
WP M WATER POLO
WR M WRESTLING

2-6. CHANGES AFFECTING FUTURE SEMESTERS (Q2i "On-Line" Registration). Schedule changes to future semesters can be made anytime before the registration deadline for that semester as advertised by DFRC. The registration deadline for the spring semester occurs in the October preceding it. The registration deadline for the fall semester occurs in the March preceding it. Advisors/AAOCAs can enter registration changes for future semesters through Q2i's On-Line Registration System. Moving a course more than one year beyond the numerical designator requires an academic waiver, approved by the Registrar.

a. Q2i On-Line Registration - Options:

(1) Add Course (add course to future semester)

(2) Move Course (move future course to a different semester)

(3) Change Course (change semesters for two future courses)

(4) Replace Course (replace future course with a new course)

(5) Delete Course (delete course from future semester)

b. Q2i On-Line Registration – Rules of Engagement:

(1) Only academic courses can be changed with Q2i (i.e. no Phy Ed and no Armnshp, except Armnshp 425 and Armnshp 490).

(2) Advisors can only change advisees' courses.

(3) AICs (Advisor In-Charge) can make changes to cadets within their major.

(4) Schedules for the current semester must be changed by DFRC after coordination with affected departments per registration guidance. After the registration deadline for the upcoming semester, advisors will not be able to make on-line changes for that semester.

(5) AICs must check and approve pending changes (manually check course prereqs).

(6) Advisors verify changes were made (view new APS next day).

(7) Only offered courses can be added in associated semesters.

(8) Q2i should, but won't always, generate warnings for underloads and overloads.

(9) Advisors should ensure courses can schedule (14 hours contact time maximum).

(10) Advisors should ensure cadets meet all graduation requirements (core and major).

c. Registration changes after the registration deadline must be IAW paragraph 2-5b.

2-7. CHANGES AFFECTING CURRENT SEMESTER. We classify any changes affecting the present semester as current semester changes. Cadets must attend the courses printed on their academic schedules until they receive a new schedule via the CAMIS webpage. Instructors are required to mark absent any cadet who does not attend class, and is still on their roster. The cadet will drop off the instructor roster at the effective time that their schedules are changed. An instructor may allow a cadet to attend class (cadet is attempting to add) during the cadet's free period until he/she receives the schedule change.

a. Checklist for Changes to Current Semester (all changes attempted after the normal registration period require appropriate department head coordination; course drops must meet the deadlines listed in the course drop timeline).

(1) Cadet and advisor/AAOCA work out desired changes, checking:

(a) Course offering check (are courses taught in semesters desired?)

(b) Core courses sequencing check

(c) Academic program courses check (are all required courses scheduled?)

(d) Prerequisite check

(e) Underload/overload check

(f) Contact hour check (are 14 or less contact hours scheduled per semester?)

(g) Duplicate course check (are any courses scheduled more than once?)

(2) Cadet and advisor/AAOCA annotate a current APS with desired changes.

(3) For current semester changes, the APS must be coordinated by the following:

(a) Cadet, advisor/AAOCA, and AIC (if the cadet has declared an academic major)

(b) Department Head for each course that is added or dropped

(c) Coordination with the following agencies, if affected by changes:

Course	***Required Coordination***	***Phone #***
Soaring Airmanship Courses	306 OSS/OSOS	3-9326
Parachuting Airmanship Courses	98 FTS	3-3653
Academy Flight Screening (AFS)	557 FTS	3-7580
Physical Education	AHPG	3-3525

b. Directed Changes.

(1) DFRR may change a cadet's schedule to correct errors or to balance course load.

(2) DFRC may make changes to implement decisions resulting from the Academic Review Committee process. If any of these changes requires a cadet to drop or add a course, DFRC will sign the annotated APS as the initiating authority or may ask the advisor/AAOCA to sign the change request as the initiating authority.

(3) Cadets will drop necessary courses or initiate a waiver during Lesson 1 to comply with the overload policy for cadets whose grade point averages at the beginning of a semester are insufficient to carry their desired enrollment (see overload policy, para 2-3d and Definition of Terms).

c. Adding a Course. To add a course after Lesson 1 of the current semester, the cadet and Advisor/AAOCA must coordinate with DFRC and submit an APS signed by the Department Head of the class being added. After Lesson 3, no courses can be added without Vice Dean approval, coordinated through DFR.

d. Dropping a Course. A cadet may drop an academic program, elective, or core course during the semester with DFRC approval if not dropping below five academic courses and 13.5 semester hours. Cadets wishing to drop Armnshp 251, 461, 472, or 473 must coordinate with the Soaring Program Manager (3-9326). Cadets wishing to drop Armnshp 425 (Academy Flight Screening) or Armnshp 454 (Navigator Academy Flight Screening) must coordinate with the 557 FTS AFS Flight Commander (3-7580). Approval to drop a course is subject to the timeline shown in Figure 2-4 and dependent upon ability to retake the course within proper sequencing guidelines.

2-8. CHANGING AN ACADEMIC PROGRAM SUMMARY. Make changes to a cadet's program by annotating required changes in RED INK on a current copy of the cadet's APS.

a. Ensure you use the most current APS available.

b. To drop courses, circle them (don't line out courses; this indicates no change to DFR personnel). If the course is circled in error, line through the circle and the class will not be dropped.

c. To add courses, write them in under the appropriate semester.

d. To change advisors, include new advisor's Social Security Account Number (SSAN).

e. To declare or change an academic program, annotate above the advisor's name.

f. Changes made to the 7th or 8th semester of a firstclass cadet must include the graduation check to allow DFRC to verify graduation requirement will be met.

Figure 2-4
COURSE DROP TIMELINE

LESSON	ACTION
M1 - T8	Course will not appear in mid-semester progress report or on official transcript. Cadets must have AAOCA/Advisor and AIC (if applicable) coordination for their intended drops along with approval by all affected department heads. (Coordination will be via signature on current APS submitted for change; approval authority is DFR.)
M9 - T21	Drops will be allowed only in extraordinary circumstances (extended hospitalization, extended emergency leave, or extenuating occurrences). Extraordinary circumstances do not include a cadet's academically deficient performance in a course. These drops are limited and must have waiver approval via USAFA Form 69 (see Figure 2-4) approved by DFV. If drop is approved, a "W" will appear on the official transcript.
M22-T30	A grade will appear on the mid-semester progress report. Cadets academically deficient as a result of this grade will be placed on academic probation and will not be eligible to come off until the end of the semester. Drop requests must be submitted via an APS coordinated through the Course Director, AIC and AAOCA/Advisor. If drop is approved, a "WP" or "WF" will appear on the official transcript. DFR is the final approval authority.
M31-Finals	No drops will be allowed except in extraordinary circumstances (extended hospitalization, extended emergency leave, or extenuating occurrences approved by DFV). Extraordinary circumstances do not include cadet's academically deficient performance in a course and do not apply to cadets changing their academic programs, even if the course they wish to drop is not required in the cadet's new program. These drops will not be approved solely to remove a deficient grade in the course and must have waiver approval via USAFA Form 69 (see Figure 2-4) approved by DFV. Drops approved in this time period will be reflected on official transcript as "WP" or "WF."

NOTES:
1. The cadet hand-carries completed APS and any required waivers to DFRC. The academic advisor or AAOCA keeps one copy of the annotated APS.

2. If the requested change does not create a graduation check failure, the requesting cadet receives a new schedule via the CAMIS webpage. If the change creates a graduation check failure or if other errors are detected, DFRC sends the annotated APS to the cadet's advisor for review/comment. Cadets must attend all courses until receipt of a new schedule via the CAMIS webpage.

2-9. WAIVERS. Use USAFA Form 69, Request for Academic Waiver (see Figure 2-5).

a. When cadets request substitute courses for core or academic program requirements, their advisors must list the specific line numbers of the requirements as listed in the Graduation Requirements Master File (found on cadets' Grad Checks or in the *Master Course File*). Advisors must also list the term (e.g., 04A is Summer 2004, 04B is Fall 2004; 04C is Spring 2005) in which the substitutes will be taken.

b. When a cadet requests a change to the approved core sequencing found in Chapter 7, the cadet must obtain the signature of the department head of the course delayed.

c. An APS and Grad Check must be submitted with the USAFA Form 69.

d. The advisor completes the appropriate portions of the form and signs it. The AIC initials approval of the form and submits it to the appropriate department head for signature. The form is taken to DFRC, who ensures the form has been completed correctly and processes the form through the final approval authority. DFRC returns disapproved waivers to advisors.

e. Final approval authorities for most waivers are as follows:

FINAL WAIVER APPROVAL AUTHORITY

TYPE OF WAIVER	WAIVER APPROVAL AUTHORITY
Core courses	
▪ Substitute	Academy Board
▪ Final exam or final report	Vice Dean
▪ Prerequisites	Appropriate Department Head
▪ Delay of core course	Appropriate Department Head
▪ Waiver of foreign language requirement	DFF Department Head
Non-core courses	
▪ Prerequisite	Appropriate Department Head
▪ Final exam or final report	Vice Dean
Academic Load	
▪ Minimum course load	Academy Board
▪ ARC-directed load	Academic Review Committee
▪ 7 courses while on academic probation	Academic Review Committee
▪ Course drop timeline (Figure 2-4)	DFR, DFV and DF
Substitutes for major's requirements	Appropriate Department Head
Minimum graduation requirements	Academy Board

2-10. INDEPENDENT STUDY COURSES. Cadets can be enrolled in independent study courses for future semesters on-line through Q2. A USAFA Form 0-498, Request Permission to Enroll in an Independent Study Course (Figure 2-7), should be submitted to DFRR by lesson 5 of the semester with the independent study. Fourth- and third-class cadets will not be allowed to enroll in an independent study course. 499 is a 3 semester hour course; 499A is a 2 semester hour course; 499B is a 1.5-semester hour course; 499C is a 1.0-semester hour course.

a. Title of Independent Study Courses. The title of an independent study course, submitted on the USAFA Form 0-498, should be short and succinct. Limit the title to 30 characters, since the title or its abbreviation will appear on the cadet's official transcript. Except in special circumstances, which the requestor should explain, the title should be different from any assigned to other cadets. No cadet may take an independent study course during the summer term without permission of the Vice Dean of the Faculty, coordinated through DFR.

b. Limit of Independent Study Courses Taken. You may apply a maximum of six semester hours of independent study to academic graduation requirements. A cadet may take only three semester hours of independent study in any semester.

2-11. SPECIAL TOPICS COURSES. Special Topics Courses (495s) must be identified at least one semester in advance to DFR. Notification should include a course description, section size, enrollment restrictions, prerequisites/corequisites, and a list of students to enroll if already selected. Unless otherwise approved by the Curriculum Committee, special topics courses are worth three semester hours and require one contact hour. Special topics courses will be listed in the Curriculum Supplement published the semester before the course is taught. Each academic discipline can offer one 495 special topics course a semester. In addition, Department Heads should clearly indicate if third-class cadets will be allowed to enroll in the course. Fourth-class cadets cannot enroll in special topics courses without DFV approval, coordinated through DFR.

2-12. AUDITING.

a. Upper-class cadets may audit a non-core course if they have at least a 2.60 cumulative GPA. An audited course will not count towards minimum course load requirements, but does factor into maximum course load requirements. Cadets must fulfill the 3.25 GPA requirement if they exceed their maximum course loads by adding a course for audit.

b. A cadet must have the approval of the appropriate department head to audit a course. The department head or the instructor has the option of refusing an audit request.

c. A cadet may not take a course for credit at any time after receiving formal permission to audit the class and after attending one period in an audit status.

d. Class attendance will be optional for an audited course.

e. The auditor need only do minimum preparation for the audited course. An auditor will not participate in graded exercises or assignments. If an instructor feels an auditing cadet is detracting from the instructor's effectiveness, the instructor may direct the cadet to withdraw from the course.

f. Cadets may request permission to audit a course after receiving their class schedules.

g. Cadets need to fill out the request letter IAW Figure 2-6. Upon completing the form letters, cadets return them to DFRR for processing and filing. The audited course will not appear on the cadet's transcript.

Figure 2-5
ACADEMIC WAIVER REQUEST
USAFA Form 69

ACADEMIC WAIVER REQUEST
(THIS FORM IS SUBJECT TO THE PRIVACY ACT OF 1974)
(Reference USAFAI 36-171 and the Curriculum Handbook)

AUTHORITY: Title 10 U.S.C., Sections 8013 and 133: E.O. 9397
PRINCIPAL PURPOSE: SSN is used for identification purposes.
ROUTINE USE: None.
DISCLOSURE IS VOLUNTARY: However, if information is not provided, waiver may not be processed.

TO
DFRR thru DFRS, DFR, DFRC, Academic Advisor

CADET NAME *(Last, First, MI)*	CLASS YEAR	SSN	SQUADRON	MAJOR	DATE
O'Neal Shaquille	2003	987-65-4321	CS-1	English	20020103

X 1. REASON FOR ACADEMIC WAIVER

X Substitute Law 360 taken in semester 01B for graduation requirement Opt (Master file line number M53LB) in English major.

Delete requirement for in major.

Delete prerequisite of for .

Substitute for as prerequisite for .

Allow concurrent enrollment in and .

Delay until semester of class year.

Underload to course units.

OTHER *(Specify)*

2. ACADEMIC ADVISOR'S JUSTIFICATION

Law 360 is term-taught with the Law and English Departments. It's an in-depth study of literary works that deal with Law. This course should be counted towards an English Option

SIGNATURE Tom Jones DEPT DFSJG DATE 1/3/02

3. COMMENTS/COORDINATION *(Reference Curriculum Handbook)*

DEPARTMENT HEAD [X] APPROVE [ ] DISAPPROVE
SIGNATURE Dale Brown DEPT DFSJG DATE 1/3/02

DFR [X] APPROVE [ ] DISAPPROVE
Dean H. Wilson
SIGNATURE DATE 1/4/02

ACADEMIC REVIEW COMMITTEE CHAIRMAN [ ] APPROVE [ ] DISAPPROVE
SIGNATURE DATE

DEAN/VICE DEAN OF FACULTY [ ] APPROVE [ ] DISAPPROVE
SIGNATURE DATE

ACADEMY BOARD [ ] APPROVE [ ] DISAPPROVE
SIGNATURE DATE

USAFA FORM 69, 20010601 *(EF-V1)* PREVIOUS EDITION IS OBSOLETE **COPY DISTRIBUTION:** Original - DFRR, Copies - DFRS, DFR, and Academic Advisor

Figure 2-6
REQUEST TO AUDIT ACADEMIC COURSE FORM LETTER

Date

MEMORANDUM FOR DFRR

FROM: C2C JOHN B. GOOD

SUBJECT: Request to Audit Academic Course

1. Request that I be permitted to audit course in section ___ the fall/spring semester 20_.

2. My cumulative GPA is _____. My latest semester GPA is _____. My graded academic course-load is _____ course units.

3. I have a free period at the hour I desire to audit this course.

4. This course is not a core or major's requirement.

5. I have not previously audited or taken this course for credit, and I understand that I will not be permitted to take this course for credit at any time after I have attended one period in an audit status, even though I may drop the audited course later during this semester.

(signature)
JOHN B. GOOD, Cadet USAFA

JERRY MAGUIRE, Capt, USAF — concur/nonconcur
Advisor, DFCE

RAYMOND CANSELLA, Maj, USAF — concur/nonconcur
AIC, DFCE

NANCY L. CUNNINGHAM, Lt Col, USAF — concur/nonconcur
Instructor of course

FRANK M. STORM, Col, USAF — concur/nonconcur
Professor and Head (or authorized signature)

Figure 2-7
REQUEST FOR PERMISSION TO ENROLL IN AN INDEPENDENT STUDY COURSE
USAFA Form O-498

REQUEST FOR PERMISSION TO ENROLL IN AN INDEPENDENT STUDY COURSE

(This form is subject to the Privacy Act of 1974)

AUTHORITY: 10 USC 9331.
PRINCIPAL PURPOSE: To obtain permission of instructor, advisor, and department head for enrollment in an independent study course. Becomes a part of Master Cadet Personnel Record available to USAF Academy instructors, counselors, advisors, and the Registrar's staff. SSN is used for identification purposes.
ROUTINE USE: None.
DISCLOSURE IS VOLUNTARY: However, if information is not provided, cadet may not enroll in independent study course.

CADET NAME *(Last, First, Middle)*	SSN	CLASS	SQUADRON

DISCIPLINE OF REQUESTED INDEPENDENT STUDY COURSE	SEMESTER	YEAR
	FALL	
	SPRING	

LIST COURSES COMPLETED/PRESENTLY ENROLLED IN THAT ARE RELATED TO PROPOSED TOPIC

I have checked the Curriculum Handbook to confirm that there is such a course offering and that I have met all course requirements.

CADET SIGNATURE	DATE

This form must be submitted to HQ USAFA/DFR prior to Lesson T1 of the affected semester. The title should be short and succinct; it or an abbreviation of it will appear on the cadet's official USAFA transcript. It must be typed or clearly printed. Except in special circumstances, which should be briefly explained, the title should be different from any assigned to other cadets.

I agree to instruct the above named cadet in a tutorial independent study course with the following title:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
LINE 1	I	N	D		S	T	U	-													
LINE 2																					
LINE 3																					

MATERIALS AND/OR EQUIPMENT REQUIRED TO ADMINISTER THIS COURSE *(If none, please indicate)*

In accordance with USAFA Curriculum Handbook, _____ semester hours will be awarded upon successful completion of this course.

INSTRUCTOR SIGNATURE	DEPARTMENT	PHONE NUMBER

I concur.

ADVISOR SIGNATURE	MAJOR	PHONE NUMBER

Permission granted.

DEPARTMENT HEAD SIGNATURE *(Department offering course)*	DEPARTMENT

USAFA FORM O-498, 19940501 (EF-V1) (HQ USAFA/DFR) PREVIOUS EDITION IS OBSOLETE

CHAPTER 3
SCHEDULING

3-1. THE ACADEMIC WEEK. The academic week in the fall and spring semesters generally consists of five days with seven 50-minute periods each. For scheduling purposes, we designate alternate weekdays as "M" and "T" days during each semester. Each two-day block (one "M" day and one "T" day) is a complete lesson. An example of a cadet's schedule, which is obtained via the CAMIS webpage, is located at Figure 3-1.

3-2. ACADEMIC COURSE SCHEDULING. DFRR has Preliminary Course Offering Information (PCOI) meetings each semester with department representatives, and the master course offering schedule is developed using course offering data, department inputs, and cadet registration information. Departments maintain accurate data on the current Master Course File listing. Each department scheduling coordinator will provide updated course file data (e.g., type of sectioning, whether or not course will be giving final exams) to DFRR upon request.

3-3. CADET EXCUSAL FROM ACADEMIC TIME. Department heads may excuse cadets from a class taught by their departments to visit specific places or agencies in the cadet duty area to perform academic research or work related to specific academic courses. When the department desires to sponsor an event which will use other than the departmentally scheduled academic time or will require cadets to depart the cadet area, the department must submit an electronic Scheduling Committee Action USAFA Form 17 request in CAMIS through their department representative at least two weeks prior to the event. You can find additional information concerning excusal and compensatory time in USAFA Instruction 36-180.

3-4. FINAL EXAMINATIONS. The Academy Board specifies the end-of-semester final examination period. DFRR schedules end-of-semester final examination times and places for all courses that indicate a final examination requirement, as shown in this handbook and in the Master Course File. Final examination periods will not be used for cadets to brief findings on course projects. Final examination periods must be used solely for written final examinations. A portion of Foreign Language final exams may include an oral proficiency evaluation. A final examination must be at least two hours in length and account for at least 25% of the course grade. Requests for changes to an individual cadet's final examination schedule must be submitted to DFRR for approval before the published deadline advertised each semester. English-As-A-Second Language (ESL) cadets eligible for extra time in final examinations must coordinate with individual instructors. If the extra time given requires rearranging other finals, the cadet must contact DFRR for rescheduling (see FOI 36-164, Policies and Procedures for Cadets Who Speak English as a Second Language).

3-5. THE SUMMER. During the fall semester, DFRC will publish a list of the upcoming summer's academic course offerings. These courses can be found on the DFR website. Summer Programs (Para 6-8) provides further information regarding summer programs.

Figure 3-1
Cadet Academic Schedule

A cadet's academic schedule reflects 'M' day and 'T' day information The common unscheduled course is PDP XXX. This is the cadet's Professional Military Education program designator. The academic periods are:

M1/T1	0730-0820 hrs
M2/T2	0830-0920 hrs
M3/T3	0930-1020 hrs
M4/T4	1030-1120 hrs
M5/T5	1310-1400 hrs
M6/T6	1410-1500 hrs
M7/T7	1510-1600 hrs

"COURSE" - course name and number**.** Phy Ed is taught in 8 lesson blocks. Armnshp is taught in 10-lesson blocks. For exact start and end lesson, please reference paragraph 3-6. Armnshp and Phy Ed courses have a suffix of A - H. Other suffixes: "H" for honors, "Y" for idea section, "Z" for experimental, "FR" is a section of 4°s, and "SO" is a section of upperclassmen.
"Section" - when the course is scheduled and which section. The suffix denotes the section when multiple sections are scheduled during the same period.
"Room" - classroom where the course meets
"Instructor" - Instructor for that section

Cadet's Name (Aca Yr/Tr: 2004 Spring) Major: GenEngr **Advisor:** Maj Timothy Scully

Course	Section	M1	M2	M3	M4	M5	M6	M7	T1	T2	T3	T4	T5	T6	T7	Room	Instructor
Physics 315	B		*													2B17	Lt Col Rick Pitino
MechEngr 492Z	A			*	*											2L6	Maj Mitch Barnhart
PhyEd 486F	A					*	*									00000	
AeroEngr 457	A									*						AL114	LtCol David E. Bossert
Engr 311	B										*					4J12	Lt Orlando Smith
Physics 310	A											*				2B11	LtCol J. Ed Wilks
PhyEd 484G	A												*	*		00000	
PDP 401	A															00000	

Figure 3-2a
OFFERING RESTRICTIONS DFR WILL CONSIDER FOR APPROVAL

1. Triple-period excusals for airmanship classes and 6th- and 7th-period and 7th-period only excusals for intercollegiate athletes.

2. Forcing course offerings to mornings only due to other duties performed by instructors.

3. Forcing course offering to one day only because:
   a. Instructor flies
   b. Instructor teaches at Peterson AFB

4. Two or more courses requesting to meet on same day or at the same offering time for team teaching, conducting group projects, etc.

5. Scheduling interdisciplinary courses back to back.

6. Instructors requesting no conflict in offering times of three courses taught by only two instructors (no back-up instructor).

7. Back-to-back offering times for lab courses that use live lab specimens.

8. Forcing course offering time to a particular day and hour for sections taught by dept head.

9. Forcing course offering to M 1/2 or T 1/2 because of weather conditions during flying phase of course.

10. No seventh-period offering in some lab courses because of safety requirements (cadet clinic closed).

Figure 3-2b
COURSE OFFERING RESTRICTIONS NORMALLY NOT CONSIDERED FOR APPROVAL

1. Forcing all sections of one course or offering times of two or more courses to one day for:
    a. Guest lecturers
    b. Instructor TDYs
    c. Field trips
    d. Instructors working on dissertation
    e. Instructor workload in department
    f. Other assigned duties (AIC/AAOCA)

2. Keeping one afternoon or morning free for:
    a. Instructors working on PhD
    b. Instructors auditing courses
    c. First-class leadership meetings

3. Requesting a specific day and hour for a course because:
    a. Instructor is department executive officer or other department staff officer
    b. Instructor is visiting professor or nonresident professor
    c. Instructor is AAOCA

4. Departments requesting:
    a. No offerings at a certain period because of department staff meetings
    b. No fourth or fifth periods so instructors can go to the gym at noon.
    c. No first, fifth, or seventh periods because it's much harder to teach cadets during those periods.

5. Back-to-back offering times of a single-hour course with more than two sections.

6. Same day offering times of multiple-period courses.

7. No double sections at an offering time to reduce administrative workload (setting up two classrooms, arranging for video to more than one room, etc.).

3-6. COURSES WITH UNUSUAL SCHEDULES.

a. Armnshp 251/472. Armnshp 251 (Soaring Student) and Armnshp 472 (Soaring Instructor) are taught in ten-lesson blocks overscheduled with physical education and require three consecutive contact hours.

b. Pseudo Courses. Physical Education 8xx and 9xx are pseudo courses scheduled for 5th, 6th, and/or 7th period. Athletes are enrolled in these courses so they may have sufficient time for practice. Armnshp 751 is also a pseudo course that blocks out an additional period if needed for Armnshp 251, 472, or other Armnshp courses.

c. Eight/Ten Lesson Block Courses. Courses that meet for 8-10-lesson blocks (Armnshp and Phy Ed) are identified with the following suffix:

Fall Semester	Spring Semester
A Block: Lessons M1 – T10	E Block: Lessons M1 – T10
B Block: Lessons M11 – T20	F Block: Lessons M11 – T20
C Block: Lessons M22 – T31	G Block: Lessons M22 – T31
D Block: Lessons M33 – T42	H Block: Lessons M33 – T42

Schedule		Phy Ed	Armnshp
Fall	A (M1-T10)	M2-T9 PFT/AFT (M10-T13)	M1-T10 AFT on Lsn 11
	B (M11-T20)	M15-T22	M13-T22 PFT on Lsn 12
	C (M22-T31)	M23-T30 MAKE-UP PFT/AFT (T31-M33)	M23-T32
	D (M33-T42)	M34-T41	M33-T42
Spring	E (M1-T10)	M1-T8 PFT/AFT (M9-T12)	M1-T10 AFT on Lsn 32
	F (M11-T20)	M14-T21 1° AF PFT (M23-T23)	M12-T21 PFT on Lsn 11
	G (M22-T31)	M24-T31 MAKE-UP PFT/AFT (M32-T34)	M22-T32 1° AF PFT on Lsn 23
	H (M33-T42)	M35-T42	M33-T42
		Summer	
1st period		3 Weeks: A, B, & C	i.e., Mil Tng 444AC
2nd period		3 Weeks: D, E, & F	i.e., Mil Tng 444DF
3rd period		3 Weeks: G, H, & I	i.e., Mil Tng 444GI

d. Twenty-One Lesson Block Courses. Reading Skills 103/103X and Reading Skills 201/201X meet for 21 lessons. The suffix identifies which 21 lessons the cadet will attend.

Lesson M1-T21	*Lesson M22-T42*
Rdg Skls 103, Rdg Skls 201	Rdg Skls 103X, Rdg Skls 201X

e. "Idea" Program. The Idea Program is a program that places cadets who are in one section of one course together in a section of another course that relates material learned in both courses. The course material taught, the GRs given and syllabi used are identical to those used in the parent courses. The course is identified on a cadet's schedule by a Y suffix.

f. Experimental Courses. Experimental courses are courses testing new instructional material. They are identified on the cadet's schedule by a "Z" suffix.

g. Study Skills 101 (Strategies for Academic Success). A two semester hour course administered by Student Academic Services (DFRL) in the fall for fourth-class cadets identified as "academically at-risk." Other cadets are welcome to take this course.

h. Study Skills 102: A one semester hour condensed version of the Study Skills 101 course. It is offered once in the spring and once in the fall after mid-semester grades are released.

i. Reading Skills 103/103X. Reading Enhancement for First-Year Cadets. A two semester hour, half-semester reading skills course tailored for fourth-class cadets. When registering for this course, please specify preference for taking course during first-half (e.g., Rdg Skls 103) or second-half of semester (e.g., Rdg Skls 103X).

j. Reading Skills 201/201X: Reading Enhancement. A two semester hour, half-semester reading skills course. When registering for this course, specify preference for taking course during first-half (e.g., Rdg Skls 201) or second-half of semester (e.g., Rdg Skls 201X). If you received credit for Reading Skills 103, you may NOT enroll in Rdg Skls 201/201X .

k. Math 104. Algebra/Trigonometry Skills Enhancement for Fourth-Class Cadets. Designed to help reinforce algebraic and trigonometric skills necessary for success in later courses. Math 104 is a pass/fail, self-paced, on-line course without established class times.

l. Double-Period Courses. Only valid laboratory courses may be double-period courses. Valid double-period academic core courses with three semester hours credit may include up to 10 syllabus-specified laboratory periods in a given semester. Other lessons must end at 50 minutes. 100-level foreign language courses are exempt from this policy and therefore may include up to 42 laboratory periods per semester. Non-core double-period courses are not affected by this policy and may include up to 42 laboratory periods per semester.

3-7. MINIMUM ENROLLMENT SIZE FOR MAJORS AND CLASSES. At least 12 graduates per major are expected to graduate yearly. If the number of graduates in a major falls below 12 yearly for two successive years, the major is placed on a warning list. After three more successive years with an average of less than 12 graduates in the major, the major will be eliminated from the curriculum unless the Dean of the Faculty approves an academic waiver. Minimum enrollment for any course, excluding independent study courses, is six cadets. No course will be taught with fewer than six cadets without a waiver from the Vice Dean.

CHAPTER 4

GRADING

4-1. GRADES AND QUALITY POINTS. A cadet's performance in any graded course of instruction is officially reported to the Registrar at mid-semester and end-of-semester or summer term as one of the following grades: A, A-, B+, B, B-, C+, C, C-, D, F, WP, WF, and I (discussed in special grades). Deficient grades include C-, D, and F. At mid-term, grades reported in courses ending before or at mid-term are final grades. Following is a list of grades, their quality points (QP), and course quality points.

GRADE	QUALITY POINTS (QPs)	COURSE QPs (3 Sem Hrs)	COURSE QPs (0.5 Sem Hrs)
A	4.0	12.0	2.00
A-	3.7	11.1	1.85
B+	3.3	9.9	1.65
B	3.0	9.0	1.50
B-	2.7	8.1	1.35
C+	2.3	6.9	1.15
C	2.0	6.0	1.00
C-	1.7	5.1	0.85
D	1.0	3.0	0.50
F	0.0	0.0	0.00

4-2. GRADES. Final grades are awarded at the end of the semester and are reflected on each cadet's official transcript. Mid-term grades are awarded after lesson T-21 but are not recorded on a transcript. Departments must ensure mid-term grades are worth 25% or more of courses' final grades. For students enrolled in summer academics and summer training programs, permanent grades are finalized in August. During all final grading cycles, semester and cumulative Grade Point Averages (GPA), Military Performance Averages (MPA), and Physical Education Averages (PEA) are recomputed and appear on each cadet's personal grade report.

4-3. DEPARTED CADET GRADE ASSIGNMENTS. Periodically, between final grading cycles, cadets permanently depart the Academy. Upon their departure, the Registrar requests final grade assignments from each department in which the cadet was enrolled by issuing a "Drop/Add Authorization Sheet" to the department. These Drop/Add sheets should be returned with a final grade assignment to DFRR within three working days. Types of grades that may be awarded are addressed in Special Grades (para 4-6). Failure to promptly return departed cadets' grades will result in an administrative hold on departed cadets' USAFA transcripts.

4-4. GRADE CHANGES. Grade changes should be sent to DFRR as expeditiously as possible so that products can be updated. Because grade change letters are microfilmed, all grade changes accomplished IAW USAFA Instruction 36-166, Assignment and Processing of Formal Grades, should be signed by the appropriate department head and be in the following format:

a. Department, Course Title and Number
b. Cadet's class year
c. Cadet's squadron
d. Cadet's name
e. Cadet's SSAN
f. Change grade from _____ to _____
g. Rationale

4-5. ACADEMIC APPELLATE PROCEDURE. A cadet may appeal a grade or other academic issue directly to the instructor and course director. If the matter is not resolved satisfactorily to the cadet, the cadet may appeal in writing to the department head concerned, stating specific objections. Under USAFA Instruction 36-166, Assignment and Processing of Formal Grades, department heads maintain ultimate responsibility for assignment of and changes to letter grades. Normally, the department head's decision is final. In appropriate cases, the Dean of the Faculty may request the appropriate division chairman to review the appeal case for overall fairness, consistency, and appropriateness, and to make recommendations to the Dean of the Faculty for final resolution.

4-6. SPECIAL GRADES. The cadet's official transcript, mid-semester grade report, or the end-of-semester grade report may contain the following notations: P (passing), N (no grade, continuing with no penalty), W (withdrawn), WP (withdrawn passing), WF (withdrawn failing), IC (incomplete controllable--a grade indicating questionable status in a course), and IU (incomplete uncontrollable). These grades carry no quality points and are not used in computing any GPA.

a. A "P" grade is awarded when a cadet is satisfactorily performing or has satisfactorily completed a non-graded course (e.g., Armnshp 251).

b. An "N" grade is a temporary computer code indicating a course has not yet been completed. "N" grades may not be awarded as final grades in a course.

c. A "W" grade is awarded when a cadet withdraws from a course between Lesson M9 and Lesson T21. If a cadet drops a full-semester course after T21, the department concerned awards the cadet a "WP" or "WF" grade, as appropriate. The academic department has three working days from the time of notification that the cadet has withdrawn from the course to forward the awarded grade to DFRR. If the cadet completed the course requirements before the end of the semester (e.g., a course that has no final exam), the department will submit a final grade to DFRR.

d. An "I" grade is a temporary grade given at the end of the semester, or a penalty grade given at a progress report. "I" grades indicate a cadet's questionable status in a course. "I" grades may be awarded in graded courses as well as in Pass/Fail courses. They may be "uncontrollable" or "controllable" incomplete grades. All "I" grades will be reported to DFRR by the suspense date outlined in the DFR "I" grade letter published at the beginning of each grading cycle. The department awarding the "I" grade sets the suspense for the cadet to

clear the grade; however, DFRR closely monitors the cadet's progress toward clearing the incomplete. When "I" grades are cleared and all course work is completed, a permanent grade will be assigned. DFRR must be notified immediately of the grade change so that all products associated with a grade change (i.e., transcripts, APSs, GPAs, Honor Lists) can be updated.

(1) Uncontrollable "I" grades indicate that work has not been completed for causes not within the control of the cadet, such as medical incapacity or emergency.

(a) Mid-semester: Uncontrollable incomplete work for full-semester courses at the mid-semester report will be awarded an "IU" grade.

(b) End-of-Semester: Uncontrollable incomplete work will be monitored by the department awarding the "IU" grade and will be completed at the earliest opportunity. The cadet is not placed on restriction or academic probation solely for this "IU" grade. An uncontrollable incomplete grade can be carried for a maximum of one year, but must be resolved before graduation.

(2) Controllable "I" grades indicate the cadet was responsible for failure to complete an assignment. Controllable causes include cadet's failure to complete an assignment considered to be important for evaluating course work.

(a) Mid-semester: Controllable "I" grade indicates that for reasons within the control of the cadet, work has not been completed. Cadets in this situation will be placed on academic probation for the next grading period.

(b) End-of-Semester: Cadets earning controllable incomplete grades will be restricted to USAFA through finals (affects cadets earning "IC" grades in courses with no final exam). If incomplete work is completed by the end of finals, a grade will be awarded and the cadet will not be placed on academic probation solely due to the "IC" grade. If incomplete work is not completed by the end of finals, the department issuing the "IC" may assign a final letter grade IAW USAFA Instruction 36-166, Assignment and Processing of Formal Grades, or allow the cadet to carry the incomplete into the next semester. It is highly encouraged that departments issue a final fall semester grade for all first-class cadets before lesson 3 of the spring semester. First-class cadets may need to add or retake a course to meet graduation requirements. Any cadet with an outstanding controllable incomplete grade at the end of a semester will be placed on academic probation and will be subject to academic disenrollment.

e. Grade assignments for 10-week block pass/fail courses. The following provides guidelines for assignment of grades to cadets who are disenrolled from Airmanship, or other ten-lesson block pass/fail courses. If the cadet withdraws from a course before the completion of all course requirements, the following criteria will be used in assignment of pass/fail grades:

(1) If the cadet completed 5 or fewer of the 10 required lessons, assign a "W."

(2) If the cadet completed at least 6 but less than 10 of the required lessons, assign either a "WP" or a "WF."

(3) If the cadet completed 10 out of 10 lessons, assign either a passing "P" or failing "F."

4-7. TRANSFER AND VALIDATION CREDIT. No quality points are awarded for transfer or validation credit. All transfer and validation credits may be applied toward graduation requirements, providing that the cadet completes a minimum of 132 semester hours in residence at USAFA. DFR enters transfer/validation credit into a cadet's record after being informed, in writing, by the academic department/agency responsible for the applicable course.

4-8. GRADE POINT AVERAGE. A cadet's semester and cumulative GPAs are determined by dividing the total quality points earned in all graded courses by the total semester hours attempted. DFRR publishes semester and cumulative GPAs to the nearest .01 for each mid-semester and end-of-semester grade report. When a cadet repeats a course, the GPA is recomputed as follows:

a. The cumulative GPA is adjusted with the previous grade being replaced by the most recent grade. Up to 12 semester hours may be replaced in the cumulative GPA in this manner, but all grades will remain on the transcript. If a cadet repeats more than 12 semester hours of courses, the grades for all additional courses repeated will not replace the previous grades, but will be calculated into the cumulative GPA along with the previous grade.

b. If a course is repeated in the same semester, both grades count in semester GPA computation. For cadets who repeat a spring course in the summer, both grades count in a combined Spring/Summer recomputed semester GPA. The cadet will remain on academic probation if the combined semester GPA is below a 2.0.

c. Students must have a passing grade to replace an "F" grade in the cumulative GPA. If a repeat "F" grade is earned, both "F" grades will count in the cumulative GPA. When a cadet takes a course for a third time and receives a passing grade, the newest grade will replace only the grade from the second attempt; the grade from the first attempt will remain factored into the cumulative GPA.

d. The semester GPA will include the grades of courses taken that semester, regardless of whether or not the course was taken previously or was subsequently repeated.

e. When considering whether or not to repeat a passed course, a cadet must note that it is the most recent grade, not necessarily the best grade, that is computed in the GPA.

4-9. MAJOR'S GPA. The major's GPA includes grades for courses designated by the Department Head responsible for that major, regardless of whether or not the course is being used to satisfy a major's requirement. Courses which count toward the major's GPA are annotated by an 'M1' ('M2' for a second major) on the academic grad check.

4-10. OVERALL PERFORMANCE AVERAGE (OPA). The graduation class standing is based on cadet cumulative Overall Performance Average (OPA). The OPA is the weighted combination of 70% Grade Point Average and 30% Military Performance Average (MPA). The top 10% are selected Distinguished Graduates.

OPA = 70% GPA + 30% MPA

4-11. GRADUATION RECOGNITION

RECOGNITION	GRADUATING CLASS	BASED ON
Distinguished Graduate	Up to 10%	(OPA)
Preference for Graduate Education	15%	(OPA)
With "Academic Distinction"	10%	(GPA)
With "Military Distinction"	10%	(MPA)
With "Athletic Distinction"	10%	(PEA)

4-12. DEAN'S LIST REQUIREMENTS. Cadets who earn a semester GPA of at least 3.0 in academic courses and are on no other probation lists will be on the Dean's list. These cadets are authorized to wear the Dean's pin on their uniform for the next semester. Physical Education grades are not included in Dean's list calculations. It is possible for a cadet to have a semester GPA over 3.0 and still not be on the Dean's list if the P.E. grades pulled the GPA over 3.0. Likewise, it is possible for a cadet to have a semester GPA slightly less than 3.0 and be on the Dean's list if the P.E. grades were low. Also note that only the semester GPA determines the Dean's list. Therefore, cadets cannot be placed on the Dean's list based on Prog (mid-semester) grades or Cum GPA. However, cadets may be removed from the Dean's list at Prog if their mid-semester grades put them on Academic probation.

CHAPTER 5

ACADEMIC DEFICIENCY AND PROBATION

5-1. ACADEMIC DEFICIENCY

a. A cadet is deficient in studies at the mid-semester progress report or the end of a semester/summer term under the following conditions:

(1) A grade of "F" or a controllable incomplete "I" grade in one or more courses, whether graded or pass/fail.

(2) Semester, core, and/or cumulative GPAs less than 2.00. Deficiencies in core GPA will not be tracked for academic probation (ACPRO) status until a cadet's 4th semester.

(3) First-class cadets are deficient and may be placed on academic probation if their majors' GPAs are less than 2.00.

b. Academic Review Committees (ARCs) review cadets in the following categories:

(1) Cadets whose academic records meet any one of the following criteria are considered to be seriously deficient in academics. The ARCs review those cadets' records to determine if the cadets should be recommended for disenrollment or if any other appropriate action is necessary.

(a) Multiple Failures. More than one "F" grade in one semester.

(b) Very Low GPA. A GPA considered being seriously deficient and warranting special consideration by the ARC. Very Low GPAs may be either semester or cumulative, and vary by semester as shown below.

SEMESTER	SEM GPA LESS THAN	CUM GPA LESS THAN	CUM CORE GPA LESS THAN
1	1.50	1.50	
2	1.50	1.70	
3	1.50	1.80	
4	1.50	1.90	2.00
5	1.50	1.95	2.00
6	1.60	2.00	2.00
7	1.70	2.00	2.00
8 or later	1.80	2.00	2.00

(c) Repeat Failure. Repeat failure ("F" grade) in the same course, whether core or elective and regardless of the number of semester hours.

(d) Two sequential semesters of either low or very low semester and/or cumulative GPA. Low, vice very low, GPAs are defined in paragraph 5-1b(2)(a).

(e) Failure to achieve a 2.00 semester or cumulative GPA in 3 sequential semesters.

(f) Multiple deficient semesters. 3°s who were deficient three of their first four semesters.

(g) Multiple Probations. Deficient in academics and aptitude, conduct, honor and/or athletic performance.

(h) Underloaded third classmen. Academically deficient third-class cadets who have not carried at least 19 semester hours in either the 3° fall or spring semester, assessing their probability of completing graduation requirements on time.

(2) Low GPA Review. Any cadet whose academic record meets any of the following criteria is considered to be deficient in academics:

(a) Semester, core, and/or cumulative GPA less than 2.00 but greater than the GPA defined in paragraph 5-1b(1)(b).

(b) For first-class cadets, a major's GPA less than 2.00.

(c) Single "F" grade. One "F" grade in an academic major, core, or elective course.

(d) Controllable "I" grade. Willful incompletion of a course requirement.

5-2. PLACEMENT ON ACADEMIC PROBATION. The guiding directive for academic probation is USAFA Instruction 36-164, Review and Disposition of Deficient Cadets.

a. All academically deficient cadets will be placed on academic probation at mid-semester, end-of-semester, and at the end of a summer term. Cadets are effectively on academic probation from the date of publication of a progress report.

b. DFRR publishes the official academic probation list after mid-semester grades are released and at the beginning of each semester.

5-3. REMOVAL FROM ACADEMIC PROBATION. Cadets will be removed from all conditions of academic probation when their semester, core and cumulative (and major's GPA for first-class cadets) performance meet the minimum GPA of 2.00 with no "F" or controllable "I" grades at mid-semester, end-of-semester, or end-of-summer term report.

a. Cadets having not yet repeated and not currently repeating a previously failed core course will remain on academic probation.

b. Cadets on academic probation at the end of spring semester remain on academic probation

through the summer, until the fall mid-semester progress report, unless conditions for probation are corrected by summer academic performance. Upon completion of summer course work, summer grades will be combined (for determining academic probation status only) with spring semester course work to determine the combined "spring-summer" semester GPAs. If cumulative and spring-summer combined "semester" GPAs are 2.00 or greater and all failed core courses have been repeated, the cadet will be removed from academic probation.

c. Cadets with outstanding controllable "I" grades will remain on academic probation until the grading cycle after the "I" grade is removed.

d. Cadets will not be removed from academic probation at any time other than indicated above unless they were placed on academic probation through administrative error. Cadets who drop a course after the mid-semester progress report are not removed from academic probation solely because the deletion of a deficient course "raises" their core, semester or cum GPA. These cadets remain on academic probation until the end-of-semester progress report.

5-4. ACADEMIC REVIEW COMMITTEE RESPONSIBILITIES

a. Mid-semester ARC. Each ARC chairman and coordinator will review the records of deficient cadets and may make recommendations or directives to cadets. No retention/disenrollment voting occurs at mid-semester meetings.

b. End-of-Semester/Summer ARC. Full voting membership ARC meetings are held at the end of each semester and at the end of the summer term. Reviews include all academically deficient cadets.

(1) The ARC recommends cadets for disenrollment, conditional turnback, and late graduation. The committees will recommend that cadets deficient in studies be disenrolled unless it is determined that both overall performance and probability of successful academic program completion justify retention.

(2) Decisions by the ARC to retain cadets are final. Should the committee decide that a cadet's overall performance and probability of successfully completing an academic program justify retention, it will recommend or direct one or more of the following:

(a) Continue with class.

(b) Seek assistance from appropriate agency (see Figure 5-1a, Block 2b).

(c) Underload or drop to a normal load during the current or future semester (See Chapter 2).

(d) Remove from advance placement course to lower-level course (coordinate with sponsoring department head).

(e) Repeat a course or complete an incomplete grade (See Chapter 4).

(f) Recommend/direct change or drop major.

(g) Recommend/direct withdrawal from or limit participation in intercollegiate athletics, with coordination through the appropriate eligibility committee and AH.

(h) Withdraw from or limit participation in extracurricular activities.

(i) Recommend/direct withdrawal from or limit participation in military duties, with coordination through 34 TRW.

(j) Be automatically reviewed at a future progress report.

(k) Direct enrollment in summer academics in lieu of leave.

(l) Any other recommended/directed action appropriate to an individual cadet's case.

5-5. ACADEMIC REVIEW COMMITTEE PREPARATION

a. Committee Coordinator Responsibilities:

(1) Ensure committee members are trained in responsibilities and procedures.

(2) Distribute cadet deficiency reports at each progress report.

(3) Prepare and distribute records review/interview schedules, agendas, and APSs as soon as possible to ARC members and academic departments prior to end-of-semester/summer ARC meetings.

(4) Prepare deficient cadet records and brief them during committee review.

b. Group and Squadron Air Officer Commanding (AOC) Responsibility: Squadron AOCs will forward end-of-semester/summer evaluations to the ARC chairmen through group AOCs. These evaluations will include any data the AOC believes to be significant for ARC decision-making (e.g., suitability for commissioning, Weekend Academic Calls to Quarters (WACQs) assigned/served, probationary status, and personal and medical information).

c. Academic Advisor/AAOCA Responsibility: Under the procedures of USAFAI 36-164, advisors have a significant role. They function as extensions of the Academic Review Committees.

(1) The ARC requires advisors to oversee cadets in all categories of academic probation in completing the USAFA Form 68, Cadet Academic Deficiency Evaluation and Probation Action Plan (see figures 5-1a and 5-1b). If ARC directives require a

scheduling change, an APS must be coordinated as soon as possible. All cadets on academic probation must be counseled within 10 duty days after the beginning of the following semester. The USAFA Form 68 is the advisor's only written statement accepted by the ARC.

(2) Advisors are primary sources of information to the ARC. Advisors must therefore serve as "detectives" or "diagnosticians" and attempt to discover the real causes of poor academic performance.

(3) The following suggestions are useful while preparing a USAFA Form 68.

(a) Understand the ARC will look unfavorably on any cadet who has needed Extra Instruction (EI) and can't document that quality EI was sought.

(b) Communicate any directives clearly to the cadet.

(c) Diagnose the problem and assist in developing a specific course of action.

(d) Don't assume that the cadet's view of his or her level of effort or standing in the course is an objective/realistic one.

(e) When you direct the cadet to see you at specified intervals, make them short enough to serve an effective oversight function. Once a month is too infrequent.

(f) The USAFA Form 68 should reflect an individualized plan, since each cadet's situation is unique and requires personalized attention to ensure academic success.

(g) If the advisor will not be available for the Cadet's appeal interview, they must submit a written comment card, memo for record, or be very clear on the USAFA Form 68 as to their retain or disenrollment recommendation and supporting bullets. They must also align an advisor from the same academic department that can advise the cadet through the appeal process.

d. Academically Deficient Cadet Responsibilities: Deficient cadets will complete a USAFA Form 68 according to the instructions and submit it to their academic advisor/AAOCA within 10 duty days after the publication of progress reports. Exception: Cadets recommended for disenrollment must complete a USAFA Form 68 with their appeal package if they intend to appeal the recommendation. If cadets fail to complete a USAFA Form 68 and deliver it to their academic advisor/AAOCA by the established deadline date, the academic advisor/AAOCA will notify the squadron academic officer.

e. Instructor Responsibilities:

(1) Mid-semester. The ARC requires instructors to complete computerized comment cards for all cadets who earned C-, D, and F grades in their course.

(2) End-of-Semester. The ARC requires instructors to complete computerized comment cards for all cadets who earned C-, D, and F grades in their courses and for all cadets listed on ARC comment card rosters.

(3) End-of-Semester ARC Interviews. Instructors may complete a letter for cadets who elect to appeal an ARC disenrollment recommendation. Granting a cadet's request for a letter is an instructor prerogative, not an institutional requirement.

(4) End-of-Summer Term. The ARC requires all academic instructors to complete a comment card on cadets who have earned a final "C-", "D", or "F" grade in their courses and for any additional cadets, as requested by the ARC. Instructors must submit comment cards to the Summer Academics Program coordinator in DFRC no later than two days after the last day of summer term classes.

f. Medical Staff Responsibilities. The medical representative will review the medical records of cadets appealing a disenroll recommendation. The medical representative need not be present at committee meetings, but if there is significant medical information, either written or verbal comments need to be prepared for the committee. A negative reply to the coordinator prior to committee meetings is required.

g. Athletic Representative Responsibilities. The athletic representative will review the athletic and physical education records of all reviewed cadets.

5-6. ACADEMIC REVIEW COMMITTEE PROCEDURES

a. Although ARCs review records and issue directives at mid-semester, they may review cadets for retention/disenrollment only at end-of-semester/summer progress reports.

b. During the review, ARCs consider all pertinent information. A profile or character sketch of the cadet is composed using information from the instructor comment cards, formal records of counseling, military performance appraisals, athletic ratings, and medical history. Cadets, advisors/AAOCAs, and AOCs do not attend records reviews.

c. ARC coordinators send notification letters, listing ARC actions and recommendations, to cadets after the records were reviewed. Advisors and AOCs receive copies.

d. Cadets recommended for disenrollment after a records review receive a letter via CAMIS and AOC notifying them of a mandatory formation to receive information about the ARC process. At this meeting, the ARC coordinators distribute official disenrollment recommendation notification letters and brief cadets on the appeal process. After receiving this documentation, cadets have 72 hours to choose one of the following two options:

(1) Personal Interview. Cadets directly address the ARC. Appealing cadets may submit written statements for consideration at the personal interview. Written appeal packages are due to the ARC coordinator no later than five days after receipt of the official notification letter. The ARC interview is the only time cadets are permitted to present

their cases verbally and/or in writing. To exercise this right, a cadet must appear in person on the date, time, and location the cadet is scheduled to appear. Cadets will not be allowed to call witnesses to testify in person before the ARC, although the advisor/AAOCA and AOC are required to attend. When preparing for an ARC interview, a cadet should do the following:

(a) Give mature consideration to the situation.

(b) Be prepared to be open and frank with the committee and, while not making excuses, discuss personal matters, if any, that affected academics.

(c) Before the committee interview, meet with the academic advisor/AAOCA to complete the USAFA Form 68 and to design an academic program that provides the best opportunity for academic success.

(d) Come into the ARC interview with a plan and be prepared to take responsibility for the success or failure of the plans. Make sure the plan is a realistic assessment of ability and potential. Set attainable goals and discontinue use of the program that netted the current poor results.

(e) Consult with current course instructors to establish a "get well" plan of action IAW the USAFA Form 68, Cadet Academic Deficiency Evaluation and Probation Action Plan.

(2) Waiver of personal interview and written statements.

e. The ARCs interview cadets who elect option (1) above no earlier than the day after appeal packages are due. After the interviews, the ARCs re-vote to retain or recommend disenrollment of the appealing cadets.

(1) The Registrar sends notification letters containing ARC actions to cadets retained after the ARC interviews.

(2) ARCs forward disenrollment recommendations to the Dean of the Faculty and the Superintendent for final decisions. If the Superintendent's decision is to disenroll the cadet, the Staff Judge Advocate (JA) sends notification letters to cadets

5-7. DISENROLLMENT PROCEDURES

a. Disenrollment of Cadets. Deficient cadets are processed for discharge or disenrollment in accordance with the provisions of AFI 36-2020.

b. Notification Procedures. JA notifies cadets of final disenrollment decisions. Disenrolled first- and second-class cadets will also be notified about decisions concerning their active duty commitments. JA counsels all disenrollees of their rights and options.

c. Legal Reexamination. Title 10, U.S.C. 9351. Any disenrolled cadet who is deficient because of failure to pass a required examination or course equivalent in any one subject is entitled to a reexamination of equal scope and difficulty in that subject, provided both the cadet's semester and cumulative GPAs are greater than or equal to 2.00 for all courses exclusive of the one failed. The cadet must apply in writing to the Office of the Registrar, Academic Affairs Division (DFRC).

(1) Notification. The Registrar notifies eligible cadets in writing. The notification letters include all pertinent information regarding the entitlement to reexamination.

(2) Cadet Acknowledgment. Cadets entitled to a reexamination must be counseled by the ARC coordinator concerning their Title 10 rights. Cadets will designate in writing their intent to take the reexamination. The written notification is due no later than ten days after receipt of the official written notification of disenrollment. Cadets electing reexamination will not out process, but will be removed from the Cadet Wing until the results of the reexaminations are known. The department offering the failed course prepares, administers, and grades the reexamination within five duty days of their notification of the request. The five duty days do not include weekend days, federal holidays, periods of authorized emergency leave, or days the cadet is admitted as an inpatient in a hospital. Cadets awaiting reexamination will not be sent TDY. The reexam will be of comparable scope and difficulty to the final examination in the failed course. Departments notify DFRC in writing of the cadet's grade for placement in the cadet's official records.

(3) The department administering the reexamination endorses the cadet acknowledgment letter, annotating the date, time, and location of the reexamination.

(4) Cadets prepare for their reexamination primarily through individual study. They will not be allowed to attend regularly scheduled classes in the courses in which they are retesting.

(5) When cadets are disenrolled at the end of fall semester or at the end of the summer term, they will attend all academic and military formations while awaiting reexamination.

(6) When cadets are disenrolled at the end of spring semester, they retest in lieu of leave.

(7) A cadet who successfully passes a reexamination is formally readmitted to the Cadet Wing. The failed course must be repeated the following offering term. (See USAFA Instruction 36-164).

(8) A cadet who fails a reexamination is not authorized to take another reexamination. The case will be forwarded for final approval of disenrollment in accordance with AFI 36-2020.

d. Readmission of Former Cadets Program (USAFAI 36-177). Cadets disenrolled academically must attend another four-year accredited university in order to qualify for

readmission. If they improve their grades and take courses that may transfer to USAFA, they may be eligible to apply for readmission under the Readmission of Former Cadets Program. The program requires interested students to again secure an Academy appointment and again complete the entire application process.

5-8. CLASS ATTENDANCE BY CADETS RECOMMENDED FOR DISENROLLMENT

a. Class Attendance by Disenrolled Cadets. Cadets recommended for disenrollment after the fall or summer semester will be placed into classes in a provisional status. Cadets recommended for disenrollment after the spring semester will be removed from first period summer academics, military training, and leave and be placed in Mission Support Group. Cadets will remain in this status until their cases have been resolved.

(1) A disenrolled cadet is immediately withdrawn from classes and begins out-processing.

(2) A retained cadet is removed from provisional status and is readmitted to the Cadet Wing.

b. Resigning Cadets. Cadets who plan to resign at the end of a semester and elect to take final examinations will receive letter grades and may be disenrolled for academic deficiency in lieu of voluntary resignation if they are deficient in studies at the final grade report. In order to avoid the possibility of academic disenrollment, a cadet must resign and be officially removed from all classes prior to the start of finals. The Director of Cadet Personnel and Administration (DPY) and DFRC will agree upon and publish the latest date a cadet may resign and still be excused from final examinations. Cadets resigning after Lesson T21, but before final examinations, will receive grades of WP or WF, as appropriate.

5-9. WHY SHOULD CADETS WORRY ABOUT ACADEMIC DISENROLLMENT?

a. First- and second-class cadets disenrolled from the Academy have an active duty service obligation. It is rare for this obligation to be waived.

b. Academic disenrollment seriously affects a student's chances of enrolling in another university, even on a probationary status. Many universities require a petition for entry and allow only one semester to correct deficiencies.

c. Academically disenrolled cadets desiring readmission into the Academy must go through the same admission procedure as new appointees and must again secure an appointment. Readmission is certainly not assured.

5-10. WHAT CAN A CADET DO TO PREVENT ACADEMIC PROBLEMS?

a. Take responsibility for his/her own academic program. Read the *USAFA Curriculum Handbook* and become an expert on his or her progression towards graduation.

b. Create a long-term plan for academic success by setting realistic, attainable goals.

c. Take advantage of all the help that is available, including EI, the Student Services Center (the Writing Center, the Academic Success and Reading Enhancement programs, and the intercollegiate study hall), and the Cadet Counseling and Leadership Development Center. Consult his or her squadron academic officer, advisor, advisor-in-charge (AIC), course instructors, and DFRC Academic Review Committee Coordinator.

d. Approach his/her scholarship to USAFA with an understanding that academic, athletic, and military performance are of equal importance to one's success at the Academy.

Figure 5-1a
CADET ACADEMIC DEFICIENCY EVALUATION AND PROBATION ACTION PLAN
(USAFA Form 68)

USAFA FORM 68 (GET-WELL PLAN)

CADET ACADEMIC DEFICIENCY EVALUATION AND PROBATION ACTION PLAN
(See reverse for instructions and reference USAFAR 537-1 and the Curriculum Handbook)

TO
ARC Chairman thru ARC Coordinator, Academic Advisor, AOC/CADO, Cadet

CADET NAME *(Last, First, MI)*	CLASS YEAR	SSN	SQUADRON	MAJOR	ARC AGENDA NO.
Othick, Matthew D.	2002	987-65-4321	12	None	

1. REASON FOR EVALUATION

X	ACADEMIC REVIEW COMMITTEE (ARC)	CATEGORIES OF ACADEMIC PROBATION	SEMESTER GPA	CUMULATIVE GPA	MAJORS GPA	REVISED APS YES	REVISED APS NO
X	Midsemester	F Chem, C- Hist	1.77	1.64			
	End-of-Semester						
	End-of-Semester Counseling for Records Review						

2. DEFICIENCY ASSESSMENT AND ACTION PLAN

a. WEEKEND ACADEMIC CALL TO QUARTERS (WACQs)

1 WACQ + 1 ("C-" Grades) + _____ ("D" Grades) + 3 ("F" Grades) x 7 = 35 TOTAL WACQs

One WACQ equals 60 minutes of study. Assign 1 automatic WACQ plus 1 WACQ per "C-" grade, plus 2 WACQs per "D" grade and 3 WACQs per "F" grade for 7 weeks. A maximum of 15 WACQs may be assigned per weekend. 1 degree cadets are exempt from serving WACQs.

CADET SQUADRON ACADEMIC OFFICER SIGNATURE

X	b. CONSULTATIONS	ONE TIME	WEEKLY NO. MTGS	WEEKLY NO. WEEKS	MONTHLY NO. MTGS	MONTHLY NO. MONTHS	c. EXTRA INSTRUCTION (EI) COURSES	ONE TIME	WEEKLY NO. MTGS	WEEKLY NO. WEEKS	MONTHLY NO. MTGS	MONTHLY NO. MONTHS
X	Assoc AOC for Academics (AAOCA)				2							
	Major Faculty Advisor											
	Major Advisor-In-Charge (AIC)											
	Learning Skills Center											
	Writing Center											
	Squadron AOC											
	Athletic/Sport OIC											
	Club/Activity OIC											
	Cadet Counseling Center											
	Medical Clinic											
	Other *(Specify)*											

d. CADET'S EVALUATION OF ACADEMIC STANDING AND PROGRAM

I received an F in Chemistry for Mid-Semester and a C- in History 202. I am continually going for EI and I have set up EI for every morning after Spring Break. I have already brought my grade out of the F range although my GRs are still below 50%. I have also been doing better in History and I am still looking to get some extra IP points for an assignment coming soon.

3. ACADEMIC ADVISOR RECOMMENDATION *(Reference Sections 3 and 4 Instructions)* X CONCUR ___ NONCONCUR X RETAIN ___ DISENROLL

I talked with Cadet Othick at length to discuss his plan. He has thought through his situation and he has realistic and effective plans to improve. He certainly is capable of getting his grades up. We will meet every other week to check on his progress.

AOC NAME AND RANK	AOC SIGNATURE	SQUADRON	DUTY PHONE	DATE
Ryne D. Sandberg, Major	Ryne D Sandberg	12	3-5555	20 Mar 98
ACADEMIC ADVISOR NAME AND RANK	**ACADEMIC ADVISOR SIGNATURE**	**OFFICE SYMBOL**	**DUTY PHONE**	**DATE**
Greg L. Lynch, Capt	Greg L Lynch	DFL	3-1234	20 Mar 98
CADET NAME AND RANK	**CADET SIGNATURE**	**SQUADRON**	**DUTY PHONE**	**DATE**
Matthew D. Othick, C4C	Matthew D. Othick	12	3-5555	20 Mar 98
AIC NAME AND RANK	**AIC SIGNATURE**	**OFFICE SYMBOL**	**DUTY PHONE**	**DATE**

USAFA Form 68, FEB 93 *(LRA) (FormFlow)* PREVIOUS EDITION WILL BE USED

COPY DISTRIBUTION: Original - Academic Advisor, Copies - AOC/CADO

Figure 5-1b
INSTRUCTIONS FOR COMPLETING THE USAFA FORM 68

PURPOSE. The academic advisor and cadet counseling session is considered an appointment with the Academic Review Committee (ARC). The appointment is assigned precedence in accordance with USAFAI 36-164. It is your responsibility to read the academic probation chapter in the USAFA Curriculum Handbook and then complete items I and 2a-c below, obtaining both your Cadet Academic Officer's and AOC's signature BEFORE meeting with your academic advisor. Your advisor will assist you in evaluating your current academic program, defining your deficiency, and developing a plan of study to deter future probationary standing. You must meet the deadline dates specified in para 4a.

1. REASON FOR EVALUATION: Check one of the three reasons for evaluation.
a. Midsemester: Check if you were placed on academic probation at either the fall or spring midsemester progress report. Annotate the categories of academic probation, progress report, semester and cumulative GPAs, and check whether or not a revised Academic Program Summary (APS) is attached to this form.
b. End-of semester. Follow instructions in para substituting end-of-semester wherever midsemester is referenced.
c. End-of-Semester Counseling for ARC Records Review: Check. If you listed on an ARC records review roster. Follow instructions in paragraph la substituting end-of semester whenever midsemester is referenced.

2. DEFICIENCY ASSESSMENT AND ACTION PLAN: Complete items 2a-c before having your AOC sign. Then submit your plan to your academic advisor.
a. Weekend Academic Call to Quarters (WACQs): Report to, your AOC/Cadet Academic Officer (CADO) for assignment of current semester WACQs. Your cadet Academic Officer must sign this block.
b. Consultations: Check appropriate consultations and annotate the required number of current semester meetings, once, weekly, or monthly.
c. Extra Instruction (EI): List current semester courses and annotate the necessary number of meetings: once, weekly, or monthly. Coordinate with the instructor of each course to ensure your plan is reasonable.
d. Cadet Evaluation of Academic Standing and Program: This section should reflect both your deficient progress report performance, and your plans for the subsequent current semester probation period and future semesters. Address the three statements below.
(1) Define your current academic standing. What courses did you earn a "C"-, "D" or "F" grade? What categories of academic probation apply to you? Think about the consequences of continued probationary status and potential ARC actions.
(2) Define the factors contributing to your academic deficiency. Discuss other problem areas including overall abilities, aptitudes, and attitudes based on demonstrated performance (academic strengths and weaknesses) study habits, military bearing and behavior, medical, social, and personal info (family, divorce, illness or death).
(3) Describe your "get well" program. Discuss alternatives such as Learning Skills Center, Writing Center, Counseling Center, and other options listed under paragraph 2b. Also, consider academic actions listed in the academic probation chapter in the USAFA Curriculum Handbook. If there is not enough space for your proposal, attach a separate page. Make three copies for all your attachments. Also, consider academic actions listed in the academic probation chapter In the USAFA Curriculum Handbook If there is not enough space for your proposal, attach a separate page. Make three copies for all your attachments
(4) APS revisions will be reviewed by the appropriate ARC chairperson for approval or disapproval. Until you receive a new schedule, you must attend the originally scheduled courses. If you submit a revised APS, and you do not receive a new schedule within two days, contact your academic advisor immediately. (Exception: APSs for cadet on the ARC records review roster will not be processed by DFRC until after the records review meeting. APSs for cadets eligible to be Interviewed, and who so elect, will be processed after the Interview.

3. ACADEMIC ADVISOR EVALUATION: This is the only written statement the ARC will accept from your academic advisor. Attachments can be made to this document.
a. During your counseling session with your advisor, you will both reach an agreement on a success oriented "get well" plan that will document in block 2d. Your advisor will check:
(1) Concur: Advisor supports your plan of action. (Exceptions noted.)
(2) Nonconcur: Advisor does not support your plan of action. (Exceptions noted.)
(3) Retain: Advisor recommends retention based on concurrent knowledge of you and the probability of successful/proficient academic and overall performance at USAFA.
(4) Disenroll: Advisor recommends disenrollment based on current knowledge of you and the probability of unsuccessful/deficient academic and overall performance a USAFA.
b. When selected to be interviewed, your advisor must provide a written statement regardless of his/her recommendations in 3a. However, your advisor may require you to rework your action plan before documenting comments. Advisor statements should briefly address the following questions. Did you realistically evaluate your strengths and weaknesses based on past performance? Did you outline all action plans and submit a revised APS that reflects your strengths? What was your attitude/demeanor during counseling? Were you just "filling a square", gaming the system, genuinely concerned, and/or actively participating in plans for your future? Known medical and personal problems should be noted If there's not enough space for your advisor's comments, suggest attaching a separate page. Make three copies of your advisor's attachments.

4. ACTION PLAN DEADLINE DATES:
a. Cadet: Submit this form to your academic advisor no later than the dates specified below. However, if you request an APS revision and you are not listed on an ARC records review roster, submit it with this form as soon as possible to your advisor to expedite ARC review and administrative processing.
(1) Midsemester: One week after the publication of the progress report.
(2) End-of-Semester: No earlier than one week after the beginning of the semester.
(3) End-of-semester (fall and spring) counseling for ARC records review: Two full duty days before the scheduled ARC if you elect to be interviewed.
b. Academic Advisor: Your advisor must complete this form no later than one week or one full duty day after your specified deadline dates in paragraphs 4a(1)-(3) and 4a(4), respectively. The Advisor-in-Charge (AIC) or Associate AOC for Academics (AAOCAs) will collect all forms, attachments, and revised APSs for their major or squadron, give a copy to you, retain the original plus one copy for themselves, forward a copy to the AOC.

Conclusion: This form will he referenced in ARC records review and interview meetings. This evaluation is an integral component of the ARC's cadet profile (instructor comment cards, records of counseling, military and athletic performance ratings, medical history, and your written statements including a revised APS), and will be considered during committee voting procedures.

CHAPTER 6

SPECIAL PROGRAMS

6-1. CADET SEMESTER EXCHANGE ABROAD PROGRAM (CSEAP). The Air Force Academy has semester-long, reciprocal, one-for-one exchange programs with several international academies. Current exchanges exist with Canada, Chile, France, Germany and Spain. The exchanges with Canada, Chile, France, and Spain occur during the fall semester of the first-class year. The exchange with Germany occurs in the spring of the second-class year. The program is grounded in Air Force Instruction (AFI) 16-109 requirements; established by AFI 16-111; and administered at USAFA in accordance with USAFAI 16-101. The purpose of the program is to strengthen USAFA cadet foreign language skills and bolster cross-cultural understanding and interoperability between the US and allied air forces.

a. Candidate Selection. Second-class cadets with a minimum 2.75 cumulative GPA, who have completed, or are enrolled in, the appropriate foreign language 321 are eligible to apply. A minimum cumulative MPA of 2.75 is required. Applicants may not be on any probationary status. It is advantageous for the applicants to complete as many language courses as possible. Eligible cadets should apply through the Office of International Programs.

b. Preparation. Cadets selected as primary or alternate for the exchange must be available all three summer periods prior to their exchange semester and could have academics without leave. Cadets will need to take academics as necessary to get the required core courses not available at the exchange academy. DFIP will organize orientation and academic classes for the various groups based on language (French, German and Spanish). Cadets will receive one cadet summer leadership credit. DFIP will work closely with DFR and 34TRS Summer Programs to ensure cadets get the courses and leadership credit they need during the summer period prior to their exchange so cadets can graduate on time. Cadets may be granted waivers to satisfy only major's requirements.

c. Transfer Credits:

(1) Canada. The Royal Military College (RMC) of Canada, located in Kingston, Ontario, was established in 1874 "for the purpose of providing a complete education in all branches of military tactics, fortification, engineering, and general scientific knowledge in subjects connected with and necessary to thorough knowledge of the military profession." The RMC offers a wide variety of programs in the areas of Arts, Science, and Engineering at both the undergraduate and graduate levels. USAFA cadets participating in this exchange have a large selection of RMC courses from which to choose. USAFA cadets must take their RMC courses in French.

(2) Chile (see Table 6.1). The Chilean Air Force Academy (*Escuela de Aviacion Capitan Manuela Avalos*) offers primarily non-technical courses. Therefore, USAFA cadets participating in the exchange must carefully manage their USAFA core course and

academic major's course requirements. While attending the Chilean Air Force Academy, some cadets might attend the *Aeronautical Polytechnic Academy* (APA) for coursework.

(3) France (see Table 6.2). The French Air Force Academy (*Ecole de l'Air*) offers predominantly technical/engineering courses in its curriculum. Successful completion of all mathematical core courses at USAFA (141, 142/152, 300/356/358) is required prior to participation in the exchange. USAFA cadets participating in the exchange must carefully manage all core and major's course requirements. DFENG will offer English 411FX during the second summer period for cadets and alternates selected for the exchange.

(4) Germany (see Table 6.3). The German Air Force Academy (*Offizierschule der Luftwaffe, OSLs*) offers no technical, scientific, or engineering courses in its curriculum. Therefore, USAFA cadets participating in the exchange must carefully manage their USAFA core course and academic major's course requirements. Participants in the exchange are automatically awarded full credit for MSS 400, Beh Sci 310, German 495, Hum 495, Phy Ed 477 plus one other Phy Ed course as applicable (see matrix in Table 6.3), and a Cadet Summer Leadership Program. No other core courses should be scheduled for the spring of the second-class year.

(5) Spain (see Table 6.4). The Spanish Air Force Academy (*Academia General del Aire*) offers a similar academic system as USAFA, and therefore has more options than some of our other exchanges. Creative scheduling of major's course requirements is a must.

(6) Visiting exchange cadets to USAFA receive Pass/Fail grades.

6-2. SERVICE ACADEMY EXCHANGE PROGRAM. (USAFAI 36-186, Cadet Service Academy Exchange Program). The Air Force Academy has a semester-long exchange program with the U.S. Military Academy at West Point, the U.S. Naval Academy at Annapolis, and the U.S. Coast Guard Academy at New London. Cadets selected for this program during their fourth semester attend the sister academy during the fall of their second-class year. An additional exchange in the spring semester of the second-class year may occur with Annapolis. Academic grades received at sister service academies transfer to USAFA and are included in the cumulative GPA. If end-of-semester grades would result in academic probation status at USAFA, the cadet is placed on academic probation upon return. Interested cadets apply through their Air Officer Commanding (AOC).

6-3. ENGLISH AS A SECOND LANGUAGE (ESL) PROGRAM. (FOI 36-164, Policies and Procedures for Cadets Who Speak English as a Second Language). Academic departments may grant up to double time on quizzes, graded reviews, and final examinations to ESL students as agreed upon by course director, instructor, and student. ESL students must be permitted to use an English or foreign language dictionary. Suitable arrangements must be made between cadets and instructors to schedule quizzes, graded reviews, and final exams. For further information, contact the ESL Program Manager in the Department of English and Fine Arts (DFENG) at 3-3930.

Table 6.1
CHILEAN EXCHANGE TRANSFER CREDIT MATRIX

Chilean Academy Courses	USAFA Equivalent Course(s)	Maximum Transferable Courses (Semester Hours) Allowed
Experience and Spanish tutorial course	**Spanish 495** Special Topics **Spanish 499** Independent Study (or **ForArStu 499** Independent Study)	Automatically credited (6 sem hrs)
Phy Ed: Indep Weights/Running Other sport or exercise	**Phys Ed 477** Independent Exercise **Phys Ed 499** Independent Study	(0.5 sem hrs each)

- ***All of the courses above, plus up to five (5) courses from the following chart.***

Aeronautics		
Aero Engr: Aerodynamics	**Aero Engr 315** Fundamentals of Aeronautics	(3 sem hrs)
Math		
Statistical Probability	**Math 300** Introduction to Statistics	(3 sem hrs)
Linear Algebra	**Math 344** Matrices and Differential Equations	(3 sem hrs)
Social Sciences & Humanities		
Economics (taught at the APA)	**Econ 332** Microeconomic Theory I **Econ 495** Special Topics	Choose 1 USAFA course (3 sem hrs)
Project Evaluation (taught at the APA)	**Mgt 495** Special Topics **Ops Rsch 495** Special Topics	Choose 1 USAFA course (3 sem hrs)
Chilean Culture	**Hum 495** Special Topics	(3 sem hrs)
History & Geography of Chile	**ForArStu 495** Special Topics **Pol Sci 495** Special Topics	Choose 1 USAFA course (3 sem hrs)
Military History & Geography	**ForArStu 495** Special Topics **MSS 495** Special Topics	Choose 1 USAFA course (3 sem hrs)
Military Strategic Studies	**MSS 400** Joint and Coalition Warfare	(3 sem hrs)
General Psychology	**Beh Sci 495** Special Topics	(3 sem hrs)
Public Administration	**Econ 459** Economics of Latin America **Mgt 495** Special Topics	Choose 1 USAFA course (3 sem hrs)
Law	**Law 495** Special Topics **ForArStu 495** Special Topics	Choose 1 USAFA course (3 sem hrs)
Labor Law	**Law 495** Special Topics **Law 495** Special Topics **Law 340*** (Legal Studies Majors only)	Choose 1 USAFA course (3 sem hrs)
Science of Administration	**Mgt 200** Intro to Management **Mgt 446** Complex Social Systems	Choose 1 USAFA course (3 sem hrs)
Logic and Philosophy of Science	**Philos 330** Intro to the Philosophy of Science **Philos 360** Applied Reasoning	Choose 1 USAFA course (3 sem hrs)

Special circumstances: USAFA cadets majoring in engineering areas may require special course scheduling at the Aeronautical Polytechnic Academy (APA) while attending the Chilean exchange.

Table 6.2
FRENCH EXCHANGE TRANSFER CREDIT MATRIX

French Academy Courses	USAFA Equivalent Course(s)	Maximum Transferable Courses (Semester Hours) Allowed
Military Courses • French AF structure, doctrine, ops • NBC warfare • CAT	**MSS 400** Joint and Coalition Warfare	Automatically credited (3 sem hrs)
Engineering Courses • Engineering	**Astro Engr 310** Introduction to Astronautics	Automatically credited (3 sem hrs)
Physical Education • Cross country running • Physical education & sports classes	**Phys Ed 477** Independent Exercise **Phys Ed 487** Soccer **Phys Ed 499** Independent Study	Automatically credited. **In addition, choose 1 other Phys Ed course, as appropriate** (0.5 sem hrs each)

- ***All of the courses above, plus up to five (5) courses from the following chart.***

Aeronautics	**Aero Engr 315** Fundamentals of Aeronautics***** **Aero Engr 341** Aero Fluid Dynamics **Aero Engr 342** Computational Aerodynamics **Aero Engr 351** Aircraft Perf and Static Stability	Choose up to 2 USAFA courses (3 sem hrs each)
Aerospace Structures Resistance of Materials	**Engr Mech 495** Elasticity	(3 sem hrs)
Weapons Systems • Signals theory • Antennas • Satellite transmissions • Noise • Active and passive sensors • Radar principles • Telemetry • Laser optics • EW • Mirage 2000 Ops Systems	**El Engr 447 Communications Systems I** **MSS 495 Special Topics in French Air Force Operations**	Choose 1 USAFA course (3 sem hrs)
Computer Systems & Flight Control • States & systems control • Kalsman-Bucy filters • Stochastic processes • Optical command • Optimization theory	**Engr 342** Linear Control System Analysis & Design	Choose 1 USAFA course
Contemporary Geopolitics • Geog of the European Union • Geography of Central Europe • Post-Communist Europe • Geopolitics of the Third World • The role of NATO in international relations	**Econ 374** Survey of International Economic Issues **ForArStu 470** France in the 20th Century **ForArStu 495W** Special Topics on France **Geog 470** Geography of Europe and Russia **Pol Sci 471** Politics of Europe	Choose up to 2 USAFA courses (3 sem hrs each)
Experience	**Hum 495** French Cultural and Military Studies **ForLang 495** Special Topics in French	Choose up to 2 USAFA courses (3 sem hrs each)

*** Highly recommended that cadets take this course prior to their exchange due to the higher level of math involved.**

Table 6.3
GERMAN EXCHANGE TRANSFER CREDIT MATRIX

German Academy Courses	USAFA Equivalent Course(s)	Maximum Transferable Courses (Semester Hours) Allowed
Leadership & Civic Education • Leadership principles • Behavior & styles • Decision-making • Combat & stress • Leadership survival training	**Beh Sci 310** Foundations for Leadership and Character	Automatically credited (3 sem hrs)
Air Power Theory & Doctrine • Luftwaffe doctrine • NATO • Arms control • Combined air ops • C3I • Logistics	**MSS 400** Joint and Coalition Warfare	Automatically credited (3 sem hrs)
German Language Studies	**ForLang 495** Special Topics in German	Automatically credited (3 sem hrs)
Experience	**Hum 495** German Cultural and Military Studies	Automatically credited (3 sem hrs)
Physical Education • Cadets must participate in calisthenics and physical education classes. In addition, they must compete on one of the following: volleyball, soccer, basketball, weight training, swimming, track & field, or diving	**Phys Ed 477** Independent Exercise **Phys Ed 482** Aerobic Fitness **Phys Ed 484** Volleyball **Phys Ed 487** Soccer **Phys Ed 486** Basketball **Phys Ed 499** Independent Study	**Phys Ed 477** is automatically credited **in addition, choose 1 other Phys Ed listed** (0.5 sem hrs each)

- ***All of the courses above, plus one (1) course from the following chart.***

Politics & History • Current politics • European politics • 18th - 20th century military history	**ForArStu 495W** Special Topics in European Studies **Pol Sci 471** Politics of Europe	Choose 1 USAFA course (3 sem hrs)

Table 6.4
SPANISH EXCHANGE TRANSFER CREDIT MATRIX

Spanish Academy Courses	USAFA Equivalent Course(s)	Maximum Transferable Courses (Semester Hours) Allowed
Experience and Spanish tutorial course	**Spanish 495** Special Topics **Spanish 499** Independent Study (or **ForArStu 499** Independent Study)	Automatically credited (6 sem hrs)
Physical Education		
	Phys Ed 477 Independent Exercise **Phys Ed 499** or other course as applicable	(0.5 sem hrs each)

- ***All of the courses above, plus up to five (5) courses from the following chart.***

Science		
Aerodynamics/Principles of Flight	**Aero 315** Fundamentals of Aeronautics	(3 sem hrs)
Engines & Rockets	**Astro Engr 432** Rocket Propulsion	(3 sem hrs)
Physiology & Flight Safety	**Biology 345** Aerospace Physiology	(*only 2 sem hrs*)
Applied Computer Science	**Comp Sci 495** Special Topics in Comp Sci	(3 sem hrs)
Electronics I	**El Engr 215** Electrical Signals & Systems	(3 sem hrs)
Applied Electronics & Applied Electronics II	**El Engr 343** Electromagnetics	(3 sem hrs)
Mechanics & Thermodynamics	Energy Systems Core Option	(3 sem hrs)
Human & Physical Geography	**Geog 350** Human Geography **Geog 351** Intro to Physical Geography	(*6 sem hrs*)
Graphic Expression Techniques	**Geog 495** Special Topics in Geography	(3 sem hrs)
Social Sciences & Humanities		
Social Psychology	**Beh Sci 352** Social Psychology	(3 sem hrs)
Social Investigation Techniques	**Beh Sci 331** Basic Research Methods & Statistical Tools	(3 sem hrs)
Military Sociology	**Beh Sci 360** Sociology	(3 sem hrs)
Political Economics	**Econ 355** Macroeconomics	(3 sem hrs)
Defense Economics	**Econ 495** Special Topics in Economics	(3 sem hrs)
International Relations	**Soc Sci 112** Geo Politics	(3 sem hrs)
Defense Policy	**Pol Sci 396** Politics of US Natl Security Policy	(3 sem hrs)
Air Support I / Air Support II	**MSS 100** Mil Theory, Strategy, and Officership	(3 sem hrs)
Defense Politics	**MSS 400** Joint and Coalition Warfare	(3 sem hrs)

6-4. ACADEMICALLY AT-RISK PROGRAM. This program is designed to provide academically "at-risk" cadets with a lighter academic load during their fourth-class year to increase their chances for successfully meeting graduation requirements. Cadets may not decline their placement into the program, nor can they volunteer for the program. Cadets may volunteer for the Study Skills 101 course.

a. "At-risk" fourth-class cadets take four academic courses and Study Skills 101 during the fall semester unless they are enrolled in both Math 130 and English 110; these cadets will take five academic courses, but are permitted to drop a course through normal drop deadlines. During the spring semester, at-risk cadets will take five academic courses. Cadets in one or more of the categories listed below may be placed in the program:

(1) Verbal Waiver (ACT < 24 or SAT < 580)

(2) Math Waiver (ACT < 25 or SAT < 560)

(3) PAR (Prior Academic Record) < 400

(4) Academic Composite < 2800

b. Procedures

(1) DFRC provides AOCs, AAOCAs, and the Student Academic Services Center with a list of academically at-risk cadets.

(2) Academically at-risk cadets are identified on the APS by enrollment in Study Skills 101 in the fourth-class fall (refer to Chapter 13, Course Descriptions, under Learning Skills).

(3) A cadet who wishes to take more than five academic courses in the fourth-class spring semester may do so if he/she qualifies for an overload (3.00 or greater fall GPA). At mid-semester, the ARC may direct any overloaded, deficient cadet to drop a course.

(4) An academically at-risk cadet who fails a course during the academic year may be directed to forfeit leave in the summer and take an academic course.

NOTE: According to USAFAI 36-155, Cadet Extra Curricular Activities Program, academically at-risk cadets may not participate in any clubs but may participate in one varsity sport during the fall semester. They may participate in the spring semester with a GPA of 2.25 or better.

6-5. HOSPITAL INSTRUCTION PROGRAM (HI). (USAFAI 36-2805, Extra Instruction and Hospital Instruction for Cadets). The HI program helps cadets maintain their academic course work at a proficient level while hospitalized. While this program is primarily for cadets who experience an extended stay due to illness or injury, extra instruction services are available for all cadets.

6-6. EXTRA INSTRUCTION PROGRAM (EI). (USAFAI 36-2805, Extra Instruction and Hospital Instruction for Cadets). Extra instruction provides an opportunity for students to meet one-on-one with their instructors to obtain additional, out-of-class assistance in academic areas. Extra instruction is the right of all cadets and is highly encouraged for cadets experiencing academic difficulty. All instructors are willing to help any cadet in need of additional academic assistance.

6-7. ACADEMY SCHOLARS PROGRAM. The Academy Scholars Program helps academically talented cadets to reach their full potential by offering a unique and challenging path through the curriculum, thereby providing the Air Force and our Nation with a pool of intellectually talented 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. This close interaction, in pursuit of a liberal education, encourages a culture of academic excellence allowing each cadet to develop his or her full intellectual capacity.

a. Background. The Academy Scholars Program addresses several academic issues at USAFA, and several trends in the Air Force, the global security environment, and higher education at the beginning of the 21st century. USAFA's efforts to recruit the best qualified applicants, in addition to the competitiveness of our cadets for graduate scholarships, support a program focused on intellectual development in the Social Sciences and Humanities, mirroring USAFA's excellent programs in the Basic Sciences and Engineering.

b. Admission to the Academy Scholars Program. Approximately 60 of the top academically qualified cadets of each new class (based on their entering academic composite and fall prog GPA) will be identified shortly after their first progress report in the fall. They will be offered the opportunity to volunteer for participation in the program starting their second semester. The goal is to have approximately 45 cadets formally enter the program. Cadets will be allowed to petition for admission to the program after their second semester if there is space available in the program. Cadets who wish to take Academy Scholars courses, but who are not formally in the program, may do so on a space available basis with the approval of the Program Director. A cadet will be considered for removal from the program if his/her GPA drops below 3.5. Additionally, any form of probation (honor, conduct, athletic, or acadmic) restricts a Scholar to course participation and from complementary opportunities.

c. Academy Scholars Program Curriculum. Scholars start by taking Hum 200 in the spring of their fourthclass year. Schedules permitting, scholars will also be scheduled into special Scholar sections of History 101, Beh Sci 110, and Soc Sci 112 that same semester. The remaining Scholars sections will be scheduled during the semesters indicated.

d. Academy Scholars Program Courses

Core Course	Academy Scholars Section	Year	Semester

English 211	or Hum 200	4°	Spring
History 101	X	4°	Spring
Beh Sci 110	X	4°	Spring
Soc Sci 112	X	4°	Spring
History 202	X	3°	Fall
Econ 200	X	3°	Fall
Law 220	X	3°	Spring
Philos 310	X	2°	Fall
Pol Sci 311*	X	2°	Fall
English 411*	or Hum 400*	2°	Spring
MSS 400	X	2°	Spring
Capstone Seminar: Statesmanship	Soc Sci 495	1°	Fall
Major's Capstone Experience	Independent Study 499	1°	Spring
* Required Scholars Courses			

6-8. SUMMER PROGRAMS. Academic, airmanship/aviation, and military training core requirements are offered during the summer. The 34th Training Wing, 34th Training Group, 34th Training Squadron, Summer Program Scheduling (34 TRS/DOS), coordinates scheduling procedures with DF, 306 FTG, and Athletics (AH). As the single point of contact for all program actions, 34 TRS/DOS also notifies cadets of flight and military training summer program registration and changes.

a. Military Training. All cadets will complete two programs per summer. For the two upper classes, one program will be a leadership program. Certain summer military training programs must be completed to meet graduation requirements. Total semester hour requirements will vary by cadet class. General graduation requirements are as follows:

(1) Core military training requirements:

(a) Basic Cadet Training (BCT) student

(b) Global Engagement (GE) student

(c) Operation Air Force (Ops AF), Air Education Training Command (AETC) Leadership, or CE Ops/Civil Engineer Field Engineering Research Laboratory (CE-FERL)

(2) Two Leadership Programs, one of which must be a Military Leadership. Military Leadership programs are:

(a) Any commander selected from the Command Selection Board

(b) BCT Cadre, GE Cadre, MSG Staff

(c) Ops AF Cadet-in-Charge, AETC Leadership, CE-FERL Leadership

(d) Cadet Aviation Instructor, Soaring Instructor, Parachuting Instructor

(e) Leadership credit can be earned in select academic year positions.

(3) Flight course for qualified cadets if headed to Undergraduate Pilot Training (SUPT): Armnshp 425.

(4) All cadets are normally assigned three weeks of leave every summer. They may choose to give up leave for a third military training program or an academic class. In order for cadets to participate in two TDY programs during the same summer, those cadets must give up their leave.

(5) The following programs are available to fulfill the additional requirement for two military training programs each summer.

MILITARY LEADERSHIP PROGRAMS:
All Cadet Commanders
Command Center
Cadet Aviation Instructor
BCT Cadre
GE Cadre
Ops AF Cadet-in-Charge
CE-FERL Leadership
MSG Staff
Soaring Instructor
Parachutng Instructor
AETC Leadership

CAREER BROADENING PROGRAMS:
Falconry
Media Flight
Honor Flight
EMT Flight
Training Squadron
Student Squadron
Space Ops Center
CE-SAME Camp
Summer Seminar
Sports Camp
Prep School Cadre
BSA Philmont Ranger

JOINT MILITARY TRNG PROGRAMS:
Marine Bulldog
Army Air Assault
Army Airborne
Navy Mini-Buds
Navy Cruise

DF COORDINATED PROGRAMS:
Summer Research
Olmsted Trips
Internship
Language Immersion
French/German/Chilean/Canadian/Spanish Exchanges
Special Projects

AIRMANSHIP/AVIATION PROGRAMS:
Academy Flight Screening (AFS)
Precision Flight Training
Aviation Instructor Training

NOTE 1: Summer Training Review Committee (STRC) – Directed Core Military Training. STRCs can direct core military training in lieu of leave during the summer if deemed appropriate

for completing graduation requirements based on circumstances surrounding incompletion of core military training during prescribed summer term.

NOTE 2: All joint military training programs as well as BSA Philmont will have limited enrollment restricted by USAFA based program manning.

NOTE 3: A cadet who successfully completes Basic Freefall Parachuting will not be eligible for Army Airborne.

NOTE 4: Cadets must have physiological training (altitude chamber) before participating in Armnshp 251. Cadets interested in becoming Soaring Instructors must take Armnshp 251 during the summer or NLT B-block during their 3° fall. Those cadets not interested in becoming Soaring Instructors should consider scheduling Armnshp 251 after B-block.

b. Summer Academics. The purpose of summer academics is to enable cadets to correct a failed grade or deficiency and allow students to achieve personal goals such as completing a major, strengthening weak areas, or preparing for special academic programs and AFS. Each fall, the DFRC Summer Academics Program Coordinator develops the next summer's academic schedule. The goal of this program is to include most core courses. Most courses will be open to all interested cadets. Registration for summer academics is during the registration period held in the spring. After the established deadline date, changes to a cadet's summer academic schedule will be reviewed on a case-by-case basis.

(1) Academic Review Committee (ARC) – Directed Summer Academics. ARCs can direct summer academics in lieu of leave if deemed necessary for the cadet to maintain an achievable course load and graduate in 4 years.

(2) Summer Academics plus Leave. This program is designed to serve academically "at risk" third-class cadets or first-class cadets who either perform below average academically but continue to demonstrate the ability to benefit from a service academy education or, to a lesser degree, maintain above average academic performance while contributing extensive time to the Academy community.

NOTE: Academics plus leave slots are limited to specific class years depending on the number of cadets needed to fill core military requirements and will vary from year to year. DFRC selects fourth-class cadets with inputs from academic advisors/AAOCAs. 34 TRS will waive one military training program during rhe summer for those who receive a summer academics plus leave slot.

(3) Summer Academics in Lieu of Leave. A number of cadets choose to register for summer academics in lieu of leave to ease future course loads, make room in their schedule for AFS, or enrich their academic programs. Cadets who wish to drop or add a summer academic course must do so prior to the end of the registration period in the spring. After that date, the only additions or deletions will be ARC actions, 34 TRS changes, or exceptions approved by DFR.

c. Airmanship Programs. Soaring and Basic Freefall are not available to first- and second-class cadets during the summer. Third-class cadets will be encouraged to participate as either Soaring student, Basic Freefall student, or in Space Orientation during the summer unless waived by 34 TRS/DOS due to academics, medical restrictions, or availability. Because of the limited number of student slots available, third-class cadets who wish to participate in Basic Freefall must volunteer, weigh less than 215 pounds, and pass a scored Physical Fitness Test (PFT). Slots will be filled on a modified OPA score (40% GPA, 40% MPA, 20% PEA).

6-9. SOARING STUDENT (Armnshp 251). Upperclass cadets interested in soaring should coordinate with their academic advisor and annotate Armnshp 251 on a paper APS during registration periods, if not otherwise scheduled in their academic program. Cadets interested in becoming Soaring Instructors must take Armnshp 251 during the summer before their third-class year or NLT B-block during the fall semester of their third-class year.

6-10. AIRMANSHIP/AVIATION COURSES. Cadets may complete Armnshp and Aviation courses during the academic year. Airmanship and Aviation courses are generally non-academic courses and do not satisfy requirements for an academic major. Cadets interested in becoming instructors must choose either Airmanship or Aviation, since a cadet may not be an instructor in both areas. The 94 FTS and DFMI must approve exceptions.

a. 98 FTS Parachuting and 94 FTS Soaring Programs (Armnshp Courses): Except for Armnshp 425 (AFS), Armnshp 461 (Cadet Soaring Instructor Upgrade), and Armnshp 492 (Jumpmaster/Instructor Training), these courses are non-academic and cannot satisfy requirements for an academic major. If after the registration deadline for the applicable semester, the 94 FTS will process requests to drop or add soaring courses, the 98 FTS will process requests to drop or add jump courses, and the 557 FTS will process requests to drop or add Academy Flight Screening. The 98 FTS's minimum entry GPA for upgrade and instructor parachuting and soaring courses is 2.6 semester or cumulative GPA, regardless of course load. Cadets will be dropped if placed on academic probation during any progress report. Parachuting and soaring courses do not factor into a cadet's course load; however, they cannot be taken by cadets on academic probation (exception: Armnshp 251, Soaring Student). If a cadet is placed on academic probation at any progress report, the ARC may remove him or her from parachuting and soaring courses. Cadets enrolled in two airmanship courses must have a 2.6 semester or cumulative GPA. Cadets in Armnshp 251 (Soaring Student), Armnshp 461 (Cadet Soaring Instructor Upgrade), Armnshp 491 (Advanced Parachute Training), Armnshp 492 (Jumpmaster/Instructor Training), and Armnshp 425 (Academy Flight Screening) cannot participate in any other airmanship programs during that course.

b. Aviation Courses: Most Aviation courses do not carry semester hour credit and therefore do not factor into a cadet's course load. Cadets enroll in these courses in the same manner and at the same time as other courses (see Chapter 2, Registration). All Aviation courses are open and encouraged for every cadet.

c. Academy Flight Screening (AFS). AFS (Armnshp 425) is USAFA's flight screening program. AFS is taken by Pilot Qualified (PQ) or Pilot Qualified – Waiverable (PW) cadets in the spring of their 2nd class year, summer before the firstie year, or during the firstie fall. Cadets must complete flight screening, or possess a Private Pilot License (PPL), to attend Specialized Undergraduate Pilot Training (SUPT). Cadets should not take AFS if they already possess a PPL, are not/will not be PQ, or do not plan on attending pilot training.

(1) AFS During the School Year. The earliest cadets can enroll in Armnshp 425 is the spring of the second-class year. The latest cadets should enroll in Armnshp 425 is the fall of the first-class year. The maximum course load, including Armnshp 425, is 6 courses. The minimum course load during AFS, including Armnshp 425, is 4 courses. Cadets should work with AH Scheduling to remove Phy Ed courses from their AFS semester and reschedule those Phy Ed course to other semesters. Intramural participation is optional for cadets while enrolled in AFS.

(2) AFS During the Summer. Enrollment in summer AFS is limited. Cadets enrolled in summer AFS will be scheduled for two periods of Armnshp 425 and one period of leave.

6-11. GRADUATE SCHOOL OPPORTUNITIES. Cadets may wish to attend graduate school or pursue careers in the biomedical, legal, or other professions after graduating from USAFA. Cadets may compete for the following programs:

a. National Competitive Scholarship Program. Cadets may compete with students from other universities for scholarships and fellowships to study for advanced degrees in the United States and overseas. Among the major scholarships available to cadets are the following: Rhodes Scholarship, Marshall Scholarship, Fulbright Scholarship, Fannie and John Hertz Foundation Fellowship, National Science Foundation Fellowship, John Stark Draper Fellowship at the Massachusetts Institute of Technology (MIT) and Rice University, Harvard University Scholarship at the John F. Kennedy School of Government, East-West Center Fellowship at the University of Hawaii, Joint Institute for Advancement of Flight Sciences (JIAFS) Fellowship at George Washington University, Program Research and Education in Space Technology (PREST) Fellowship at George Washington University, University of Washington Engineering Fellowship, the University of Maryland Scholarship and the RAND Graduate School in Santa Monica, CA. Scholarship/Fellowship recipients will incur an active duty service commitment (ADSC). For additional scholarship opportunities, contact the Graduate Studies Programs Office (Room 1A97, x3-4172).

b. Graduate School Program (GSP). This program allows selected graduates of the Air Force Academy to attend a twelve-month master's degree program immediately following graduation. GSP participants will incur an ADSC.

(1) Number of slots available is determined by the Air Force Educational Resources Board (AFERB). The GSP slots will be used for departments to bring graduates back to teach. A number of slots are reserved for the Dean of the Faculty.

(2) Candidates for this program must be willing to return to the Academy as academic instructors after gaining Air Force experience. Interested cadets should contact their Advisor-in-Charge or the GSP departmental representative to receive further details.

c. Future Graduate Studies Opportunities. Graduates in the top 15 percent of each class will be given preference for future graduate education (NOTE: Graduates who elect to enter graduate school under a scholarship or fellowship immediately upon graduation are not eligible for selection under this program). Selected officers will enter graduate school according to individual development and assignment policies. Graduates may apply for any graduate degree program for which they are qualified and for which the Air Force has a requirement. Selection is not limited to programs in which a quota may exist at the time. Individual preferences for particular graduate schools will be considered, although Air Force policies and requirements may necessitate assignment elsewhere. Graduates not in the top 15 percent of their class may be considered along with all other officers as Air Force openings for advanced degrees occur. Cadets desiring additional graduate education information should contact the Graduate Studies Programs Office (x3-4172).

d. Health Professions. Select cadets may be allowed to enter several health related professions after graduation.

(1) *Medicine*: Cadets meeting USAFA's requirements may compete for scholarships to medical school. For medical training, graduates can attend any CONUS medical school, including the Uniformed Services University of the Health Sciences (Bethesda). Graduates attending medical schools are funded through the Health Profession Scholarship Program (HPSP). The HPSP pays for tuition, books and other required expenses, and provides a cost of living stipend. HPSP recipients incur additional commitments to the Air Force.

(2) *Dentistry and Nursing*: Depending on the needs of the Air Force, graduates may pursue dental or nursing school after completing one or two operational tours post-graduation. Officers interested in dentistry can compete for an HPSP scholarship to attend any CONUS dental school. Opportunities and potential mechanisms for entry into nursing school post-graduation are currently being determined. Immediate entry into dental or nursing school after graduation requires Secretary of the Air Force level waiver of current Air Force policy.

(3) Cadets interested in any health profession career field or healthcare-related opportunities should contact the Health Professions Advisor in the Department of Biology (DFB).

e. Legal Training. Graduates may apply for one of the Funded Legal Education Program (FLEP) slots available each year. The number of slots varies from year to year, depending upon the needs of the Air Force. In recent years, the number of slots has been between six and eight. Those selected by the Judge Advocate General enter law school after two years of commissioned service. Applications must be submitted to the Staff Judge Advocate at the

nearest Air Force base between 1 January and 1 March of the calendar year in which the applicant intends to enter law school. Eligibility ends after the sixth year of service. A second program available to officers who desire to become lawyers is the Excess Leave Program (ELP). The number of applicants accepted annually varies according to requirements for Judge Advocates. Officers who complete either program are normally designated as Judge Advocates and serve in various legal positions in the Air Force. For more information about either program, contact the Law School Advisor (3-3680).

6-12. SCHOLARSHIP PREPARATION. Suggested courses for scholarship preparation are listed below. Cadets who are considering applying for scholarships or fellowships are encouraged to take the GRE during the spring semester of their second-class year. Cadets desiring additional graduate education information should contact the Graduate Studies Programs Office (3-4172).

a. Suggested Courses for Non-technical Scholarship Preparation:

(1) Core Courses: Schedule before or during fall of first-class year.

Hum 200, Introduction to the Humanities
English 411, Advanced Composition and Public Speaking
Philos 310, Ethics
Hum 400, Humanities Seminar

(2) Electives (Strongly Recommended): Cadets should schedule for fall of first-class year to retain flexibility, should they decide not to compete for scholarships.

Engineering/Humanities/Social Science 400
Econ 374, Survey of International Economics Issues
English 360, Classical Masterpieces
History 482, History of Science and Technology
History 457, History of Military Thought
*History 480, Studies in American Civilization
*History 498, Global Dimensions of History
*Hum 430, The Holocaust
Philos 390, Great Philosophers
Pol Sci 301, Political Theory
Pol Sci 396, Politics of US National Security Policy
Pol Sci 491, Capstone Seminar in Political Science

(3) Electives (Good Preparation): Second-class year or fall of first-class year.

Beh Sci 352, Social Psychology
Beh Sci 360, Sociology
Econ 351, Comparative Economic Systems
Econ 473, Public Finance
Econ 478, Seminar in Defense Economics
English 461/462, British Literature
Fine Art 451, Introduction to the Visual Arts
Fine Art 458, Music Appreciation

History 320, History of Technology and Warfare
History 394, The American Way of War
History 483, Great Americans
Law 351, U.S. Constitutional Law
Law 461, International Law
Philos 390, Great Philosophers
Philos 401, Comparative Religion
Philos 402, Philosophy of Religion
Philos 495, Seminar in Philosophy
Pol Sci 451, American Political Thought
Pol Sci 460, Comparative Security Policy and Civil-Military Relations
Pol Sci 495, Special Topics in Political Science
Soc Sci 483, Principles of Negotiation and the Mediation Process
*Please check with individual departments to confirm availability of courses.

b. Suggested Courses for Technical Scholarship Preparation:
Math 342, Numerical Analysis with Differential Equations
Math 360, Linear Algebra
Math 469, Partial Differential Equations
Math 470, Mathematical Physics
Physics 355, Classical Mechanics

c. Suggested Courses for Non-Engineering Majors Pursuing Engineering School: The following technical/engineering courses should be included in a non-engineering major's course sequence if the cadet has aspirations to pursue an engineering degree in graduate school:
Math 243, Calculus III
Math 253, Advanced Placed Calculus III
Math 245, Differential Equations
Additional mathematics courses, when possible

6-13. BASIC METEOROLOGY PROGRAM (BMP). The BMP is an opportunity for newly accessed officers from any commissioning source (USAFA, OTS, and AFROTC), to pursue a post-baccalaureate program in meteorology, with follow-on inclusion into the weather officer career field (15W). The BMP, managed by the Air Force Institute of Technology (AFIT), is a challenging non-degree program that averages 10-11 months in length.

a. It consists of:

(1) Minimum of 24 semester hours of junior/senior level (possibly some graduate) courses in meteorology, with three semesters of course work in meteorology being the norm (on the order of 36-42 semester credit hours over summer, fall, spring)

(2) Collateral study in mathematics, physics, and computer science may be required

(3) BMP does not count against an individual's total 54-month allotment of AFIT

graduate education time

(4) A 3-year ADSC is incurred--served concurrent with any existing ADSC--ADSC clock starts on program completion

(5) In certain cases, a BS in Meteorology may be attainable, assuming university prerequisites and/or requirements are fulfilled either prior to or as part of the BMP program

b. BMP candidates must be commissioned prior to program entry and possess a bachelor's degree in a technical field such as math or physics. Other degrees may be accepted depending on the applicant's math and physics coursework background. Eligibility requirements are determined by AFIT/CIGW. The current standards are as follows:

(1) Typically a 2.8 minimum GPA required, both overall and within a student's major discipline

(2) Minimum prerequisites include one year of calculus-based physics and one year of calculus through integral calculus (generally Calc I, II, III sequence) with minimum grades of "C" in each prerequisite course

(3) A course in Differential Equations is also strongly recommended prior to program entry or else it will need to be taken as part of the BMP

(4) Exceptions may be possible on a case-by-case basis--approved by AFIT/CIGW

c. Interested cadets should consult with the USAFA Meteorology Advisor-In-Charge (AIC) or alternate AIC to inquire about the BMP, the USAF Weather Career Field, or to enroll in potentially helpful USAFA meteorology courses (e.g., Academy or Major's Options) in preparation for BMP.

SECTION II

CHAPTER 7

CORE COURSES

7-1. CORE COURSE: All cadets must complete mandatory courses referred to as the core. Core courses form the foundation around which all majors are built. Cadets are required to take 85 semester hours of DF academic core courses, in addition to 6 semester hours of Military Strategic Studies and 5 semester hours of Physical Education.

7-2. CORE REQUIREMENTS Below is a listing of core requirements by division. Cadets who fail an alternate core course may not repeat the course, but must take the original core course.

DIVISION COURSE DESIGNATOR		SEMESTER HOURS
BASIC SCIENCES		
Biology	215	3.0
Chemistry	141 and 142	6.0 total
or Chemistry	222	
Computer Science	110	3.0
Mathematics	141	3.0
Mathematics	142 or 152	3.0
Mathematics	300, 356 or 377	3.0
Physics	110	3.0
Physics	215	3.0
ENGINEERING		
Engineering	100	3.0
Engineering Mechanics	120	3.0
Aeronautics	315	3.0
Astronautics	310	3.0
Civil Engineering	210	3.0
Electrical Engineering	215 or 231	3.0
SOCIAL SCIENCES		
Behavioral Science	110	3.0
Behavioral Science	310	3.0
Economics	200	2.0
Law	220	3.0
Management	200	2.0
Political Science	311	3.0
Social Science	112	3.0
HUMANITIES		
English	111	3.0

English	211 or 341	3.0
or Humanities	200	
English	411 or 370	3.0
History	101	3.0
History	202	3.0
Military Strategic Studies	100	3.0
Military Strategic Studies	400	3.0
Philosophy	310 or 311	3.0

INTERDISCIPLINARY

Energy/Systems Option 3.0

(One of the following courses: Engr 311, Physics 421, Chem 335, AeroEngr 241, Mech Engr 312, Ops-Rsch 310, Geog 310)

NOTES:

1. Chemistry course level will be determined by summer placement examination, credit transfer, or AP scores. Chem 222 fills the requirement for cadets who do well on the DFC placement exam but haven't had the prerequisite lab experience expected of cadets. Cadets successfully completing Chem 222 receive validation credit for Chem 141 and 142.

2. Mathematical Sciences and Operations Research majors must take Math 377 to fulfill the core requirement. Economic majors must take Math 356. Technical departments have the option to require their majors to take Math 356. All other cadets must take Math 300.

3. El Engr 231 must be taken by Aeronautical Engineering, Astronautical Engineering, Civil Engineering, Computer Engineering, Computer Science, Electrical Engineering, Engineering Mechanics, Environmental Engineering, Mechanical Engineering, Physics, and System Engineering majors. Majors in other disciplines requiring greater knowledge of linear circuit analysis and transducer systems may also take this course. If both El Engr 215 and El Engr 231 are taken by a cadet, the cadet will receive credit for both courses due to the significant differences in the material covered in each course.

4. Philosophy 311 will serve as a core alternate for cadets with DFPY Department Head permission.

5. English 341 will serve as a core alternate for English 211 for any cadet with DFENG approval. English 370 will serve as a core alternate for English 411 only for cadets pursuing the English major.

6. Humanities 200 is a core substitute for English 211. To take Hum 200, students must have Humanities Chair approval. Hum 200 is an interdisciplinary course designed to lay the foundation for further study in the disciplines of the Humanities.

7. The Academy's core curriculum is a carefully chosen and designed collection of integrated courses that are crafted to prepare cadets for outstanding service as Air Force officers. The

Academy staff has prepared a number of briefings and activities to help cadets gain a better appreciation of the core and make the most of their core experience. In briefings to the entering class of cadets at the start of each fall semester, the Dean of the Faculty and the Division Chairs provide the new cadets with an overview of the core curriculum, explaining the rationale for its design and illustrating its value for officer preparation. For scheduling purposes, these briefings most likely will occur during the second hour of Chemistry classes. Then, early in each core course, the section instructor or a department leader introduces the course and sets it in the context of the Dean's briefings. As the core course progresses, cadets are alerted to the many ways the course relates to other core courses and to preparation for service in the Air Force officer corps. Finally, for at least one lesson toward the end of the semester, cadets in each core course complete an active-learning "capstone" exercise or case study that explicitly illustrates the relevance of this particular course to contemporary Air Force operations. Taken together, these briefings and activities, coupled with carefully crafted learning experiences and assignments, equip cadets with a breadth of integrated fundamental knowledge across the full spectrum of academic disciplines and help them hone their skills in applying this knowledge to the unique tasks of the military profession.

8. USAFA's foreign language requirement, specific to each major, is an in-residence requirement. The foreign language requirement (0, 6, or 12 semester hours) can only be fulfilled by courses in the same foreign language, unless otherwise waived by the Department of Foreign Languages (DFF). DFF, based on placement testing, determines where in a language sequence each cadet starts. For cadets placing above the 100-level in a foreign language, validation credit for the 100-level courses in that foreign language sequence will be awarded upon successful completion of four foreign language courses at the 200-level or above in that same language. A small number of cadets from an incoming class validates the foreign language requirement completely each year. For those cadets, DFF will immediately award validation credit. Based on their foreign language proficiency, these cadets will receive validation credit for the two 100-level courses (131/132) in their proficient foreign language. Additionally, cadets validating the foreign language requirement (those awarded validation credit upon entering USAFA based on DFF's evaluation) are not required to take additional foreign language courses, unless specifically required by their major. For instance, most cadets with a major in the Social Sciences division take four foreign language courses. A cadet with foreign language validation in a Social Sciences major would have two of the required foreign language courses fulfilled by the validation credit. The other two foreign language requirements for the major could then be fulfilled by any two 3.0 semester hour courses (via USAFA Form 69 Academic Waiver Request), as approved by the major.

7-3. <u>CORE SEQUENCE</u> Cadets will take academic core courses within one year of their course number indicators. For example, while cadets should take a 200-level course their third-class year, they may be able to move the course into the fourth-class or second-class year; they may not move the course to the first-class year. DFRC is the final approval authority for waivers to this policy. DFRC will approve as long as a delayed core course will not result in prerequisite problems for follow-on core or academic program courses.

7-4. <u>PREREQUISITES FOR CORE COURSES</u>:

COURSE	PREREQUISITES	COURSE	PREREQUISITES
Engr 100	*Math 141	**History 202**	History 101
MSS 100	N/A	**Civ Engr 210**	Engr 100
History 101	N/A	**English 211/341**	English 111
Beh Sci 110	N/A	**Biology 215**	Chem 141
Comp Sci 110	N/A	**El Engr 215**	Math 142
Physics 110	*Math 142/152	**Physics 215****	Physics 110 & Math 142/152
English 111	N/A	**Law 220**	N/A
Soc Sci 112	N/A	**Math 300**	Math 142/152 or dept approval
Engr Mech 120	Math 141 & Engr 100	**Astro Engr 310**	Math 142, Engr 100, & Physics 110
Chem 141/142/222	N/A	**Beh Sci 310**	Mgt 200
Math 141	N/A	**Philos 310**	N/A
Math 142	Math 141	**Pol Sci 311**	N/A
Econ 200	Math 141	**Aero Engr 315**	Engr Mech 120, Physics 110, & Comp Sci 110
Hum 200	Humanities Chair Approval	**MSS 400**	MSS 100
Mgt 200	Coreq: Beh Sci 110	**English 411/370**	English 211

* Can be concurrent ** Must be in the semester following successful completion of Physics 110

7-5. CORE PREPARATION COURSES: Cadets may be directed into one or more core preparation courses. These courses meet graduation requirements and can count towards USAFA residency requirements in addition to filling the Academy Option in their majors.

a. English 109. English 109 is a three-semester hour course, scheduled for international or ESL cadets. Whenever possible, ESL cadets will take English 109 their first semester, English 111 their second semester, and English 211 their third semester.

b. English 110. English 110 is a three-semester hour academic writing course. The English and Fine Arts Department identifies cadets who need English 110. Cadets will be enrolled in English 110 their first semester and in English 111 their second semester.

c. Math 104. Math 104 is a self-paced, on-line algebra/trigonometry skills enhancement course for fourth-class cadets. This course does not fill any graduation requirements and is only taken by cadets that score marginally on the USAFA algebra/trigonometry placement exam given shortly after arrival at USAFA.

d. Math 130. Math 130 is a 3-semester hour pre-calculus math course. Cadets are placed based on results of placement testing held during BCT. Selected cadets will take Math 130 their first semester, Math 141 their second semester, and Math 142 their third semester.

7-6. UNSATISFACTORY PROGRESS IN FOURTH-CLASS ACCELERATED OR ADVANCED COURSES: During their fourth-class year, if cadets do not satisfactorily complete accelerated or advanced courses, they will normally be awarded a "W" grade in those courses. Cadets may seek an exception to this policy by submitting a request to the appropriate

department head, then to the Dean of the Faculty for approval. In the fourthclass year, cadets will not be considered deficient in studies solely because of the failure and the resulting "W" grade in an advanced course. The appropriate academic departments will notify the Academic Affairs Division (DFRC) of necessary changes required by the award of "W" grades and will indicate which courses cadets must take in future semesters. The following list is a guide:

Accelerated/Advanced Course Failed	***Then Credit Given for (Note)***	***Cadet Must Complete Following Course by Second Semester***
Math 152	Math 141	Math 141 or Math 142
Math 253	Math 142	Math 142 (optional)

NOTE: Validation credit only; no GPA impact. Cadets may choose to forfeit this validation and take this course second semester.

7-7. PHYSICAL EDUCATION COURSES. After acceptance into the Cadet Wing, the Class of 2006 and subsequent classes must pass a minimum of 10 Physical Education (Phy Ed) courses, each worth 0.5 semester hours of course credit. With few exceptions, cadets take Phy Ed courses each of their eight semesters. Each course consists of an 8-lesson block of instruction. The only exception is Phy Ed 119, Basic Swimming, which is a 16-lesson block. Two Phy Ed courses will be taken in the fourth- and first-class years. Three Phy Ed courses will be taken in the third- and second-class years. The following is the normal Phy Ed progression:

	1	**2**	**3**
4th Class	Boxing or Wrestling (M), Self Defense (W)	Physical Development	
3rd Class	Swimming	Water Survival	Individual Sport Elective (Tennis/Racquetball/Golf)
2nd Class	Unarmed Combat I	Unarmed Combat II	Team Sport Elective (Volleyball/Basketball/Softball/Soccer)
1st Class	Open Elective	Open Elective	

a. Basic Cadet Training (summer before fourth-class year); Phy Ed 100, Basic Physical Training (Pass/Fail)

b. Core (required) courses: 3 combatives, 2 aquatics, and physical development

Phy Ed 110	Boxing (males only)
or Phy Ed 115	Wrestling (males only)
or Phy Ed 114	Self-Defense (females only)
Phy Ed 111	Swimming
or Phy Ed 119	Basic Swimming
Phy Ed 112	Physical Development
Phy Ed 222	Water Survival (prereq: 111 or 119)

or Phy Ed 211	Basic Water Survival (prereq: 111 or 119)
or Phy Ed 219	Basic Swimming II (prereq: 119)
Phy Ed 215	Unarmed Combat I
Phy Ed 315	Unarmed Combat II (prereq: 215)

c. Individual Sport Electives (Required to have at least one of the following):

Phy Ed 340	Racquetball
Phy Ed 341	Tennis
Phy Ed 342	Golf

d. Team Sport Electives (Required to have at least one of the following):

Phy Ed 484	Volleyball
Phy Ed 486	Basketball
Phy Ed 487	Soccer
Phy Ed 488	Softball

e. Open Electives (Required to have at least two of the following):

Phy Ed 483	Scuba
or additional	Team or Individual Sport Elective(s)
or Phy Ed 477*	Independent Exercise (first-class cadets only)
or Phy Ed 479*	Cadet Instructor (first-class cadets only)

* Cadets are registered for these courses, due to unique medical situations, by the Athletic Department Scheduling and Grading Division (AHPG).

f. Intercollegiate Courses (Substitute Phy Ed course credit for each year on an intercollegiate roster):

Phy Ed 152	4th-Class Intercollegiate Sports (sub for Phy Ed 112)
Phy Ed 252	3rd-Class Intercollegiate Sports (sub for Individual Sport Elective)
Phy Ed 352	2nd-Class Intercollegiate Sports (sub for Team Sport Elective)
Phy Ed 452	1st-Class Intercollegiate Sports (sub for Open Elective)
Phy Ed 8XX*	
Phy Ed 9XX*	

* These are scheduling codes. They are not actual courses and do not fill any graduation or Phy Ed course requirements.

g. 42-Lesson Academic Phy Ed Courses:

Phy Ed 440	Physiology of Exercise (3 sem hrs)
Phy Ed 460	The Art and Science of Coaching (3 sem hrs)
Phy Ed 499	Independent Research (3 sem hrs)
Phy Ed 499A	Independent Research (2 sem hrs)

Phy Ed 499B	Independent Research (1.5 sem hrs)
Phy Ed 499C	Independent Research (1 sem hr)

CHAPTER 8

ACADEMIC PROGRAMS

8-1. PURPOSE OF THE ACADEMIC PROGRAM SECTION:

a. Selecting an academic program is one of the most important decisions a cadet makes during his or her career at USAFA. This handbook is designed to help make the best choice possible. The program chosen dictates which classes to attend, how many courses to take, future career fields, and graduate school opportunities. Cadets must be active participants in choosing and designing their academic programs and monitoring their progress.

b. To determine their preference for an academic major, cadets should consider the kind of work they would like to do; read AFM 36-2105 (especially atch 7), which describes specialties; and consult their AAOCA, sponsor, career counselor, and an academic advisor or the Advisor-in-Charge in that discipline. Cadets who determine their preference early enough can prepare to compete for limited entry specialties.

c. For more information concerning majors, courses and career paths, many departments have Home Pages on the World Wide Web at: http://www.usafa.af.mil/

8-2. HOW TO USE THE ACADEMIC PROGRAM SECTION: The majors' requirements in this section apply to the Class of 2007 and subsequent classes. Programs are divided by type: divisional majors, disciplinary majors, and minors. Each program is described in a similar format, telling about the program, program requirements, and a suggested course sequence. AAOCAs can help cadets find the appropriate person to talk to before registering for courses.

8-3. TYPES OF ACADEMIC PROGRAMS: USAFA offers a total of 32 academic majors and two minors. The departments offer two types of majors: disciplinary and divisional. There are 23 disciplinary, 4 divisional and 5 interdisciplinary majors. The programs and sponsoring division or department are listed below

MAJOR/MINOR	SPONSORING DIVISION OR DEPARTMENT	REQ SEM HRS
BASIC SCIENCES DIVISION		
Basic Sciences Divisional Major	Basic Sciences Division	141
Biology Major	Biology	147
Chemistry Major	Chemistry	147
Computer Science Major	Computer Science	147
Mathematical Sciences Major	Mathematical Sciences	147
Physics Major	Physics	147
ENGINEERING DIVISION		
General Engineering Divisional Major	Engineering Division	141
Aeronautical Engineering Major	Aeronautics	147
Astronautical Engineering Major	Astronautics	148
Civil Engineering Major	Civil Engineering	147
Computer Engineering Major	Computer Science, Electrical Engineering	147

Electrical Engineering Major	Electrical Engineering	147
Engineering Mechanics Major	Engineering Mechanics	147
Environmental Engineering Major	Civil Engineering	147
Mechanical Engineering Major	Engineering Mechanics	147
Systems Engineering Major	Engineering and Social Sciences Divisions	147
HUMANITIES DIVISION		
Humanities Divisional Major	Humanities Division	141
English Major	English and Fine Arts	147
History Major	History	147
Foreign Language Minor	Foreign Language	*
Philosophy Minor	Philosophy	*
SOCIAL SCIENCES DIVISION		
Social Sciences Divisional Major	Social Sciences Division	141
Behavioral Sciences Major	Behavioral Sciences and Leadership	147
Economics Major	Economics and Geography	147
Geography Major	Economics and Geography	147
Legal Studies Major	Law	147
Management Major	Management	147
Political Science Major	Political Science	147
Systems Engineering Management Major	Social Sciences and Engineering Divisions	147
INTERDISCIPLINARY		
Foreign Area Studies Major	Economics and Geography, History Foreign Languages, Political Science	147
Meteorology Major	Economics and Geography, Physics	148
Military Strategic Studies Major	Military Strategic Studies	147
Operations Research Major	Computer Science, Economics and Geography, Mathematical Sciences, Management	147
Space Operations Major	Astronautics	147
* To earn a minor, cadets must complete the specific minor's requirements and the requirements for one or more of the divisional, disciplinary, or interdisciplinary majors. Cadets with divisional majors must complete at least 147 semester hours to qualify for a minor. Cadets may earn more than one minor provided the specified criteria are met for each.		

8-4. ACADEMIC PROGRAM REQUIREMENTS: Beyond core courses, majors require an additional 45-52 semester hours to include 3 semester hours of Academy Option and 0-12 semester hours of foreign languages.

8-5. INITIAL CHOICE OF PROGRAM: Each semester, the faculty hosts Majors' Night, an event designed to give cadets the opportunity to explore academic programs and talk with program representatives. While exploring programs, cadets can seek advice from their AAOCAs. After selecting a program, cadets should seek assistance primarily from their assigned academic advisors. While the information in this chapter may be useful to AAOCAs and academic advisors, its purpose is to answer common questions cadets often have regarding academic programs.

8-6. TIMELINE TO DECLARE A MAJOR: If you plan to major in Aeronautical Engineering, Astronautical Engineering, Civil Engineering, Electrical Engineering, Engineering Mechanics,

Environmental Engineering, General Engineering, Mathematics, Materials Science, Mechanical Engineering, Meteorology, Operations Research, Physics, or Space Operations, you should plan to take Math 243 your third semester if Math 253 was not taken during the fourth-class year. If you plan to major in Computer Engineering, you should plan to take Math 245 your third semester. If you are planning to major in Computer Science or Computer Engineering you should declare before the registration deadline of your second semester and plan to enroll in Comp Sci 210 third semester. You must declare a major before the registration deadline in the fall semester of your third-class year. See your AAOCA or academic advisor to discuss the requirements for the majors in which you have an interest. You should also attend Majors' Night for in-depth academic program information. The process of declaring a major entails deciding on a course of study and scheduling a specific sequence of courses that meets graduation requirements. You can change your major. However, all majors have required non-core, 200-level courses, so, the longer you wait the more difficult it may get. Third-class cadets will not be permitted to depart on Thanksgiving Break until they have declared an academic major.

8-7. CHANGE OF MAJOR. You may change majors at any time preceding the deadline described in para 8-6. Initial selection or change of program should be timed so that no changes need be made for the current semester.

8-8. HOW DO I CHOOSE AN ACADEMIC PROGRAM? Many factors go into deciding what program to choose. The first question you should ask yourself is, "What do I want to do once I am commissioned?" Talk to officers in varied career fields. Ask them what their majors were in college and ask if their majors are enhancing their career efforts. Remember, your major can dictate what career fields you may be eligible to enter. Even if your goal is to fly, your major can open or restrict future career opportunities. Many career fields have specific requirements or are limited in the numbers they accept each year. Remember, what job you do after commissioning will be determined by Air Force requirements, by your qualifications, and by what you want to do. For more information concerning careers in the Air Force, Cadet Personnel (DPY) keeps up-to-date career briefs.

a. After you have looked at Air Force requirements, consider what courses interest you. As you progress through the curriculum, the courses often become more difficult. If you are interested in a subject, you will more likely spend the time needed to do well in those courses. Look to your academic strengths. Even though you may like a particular major, if you do not do well in those types of courses, it is highly unlikely that you will succeed at that major. Talk to your AAOCA; he or she can be one of the most important people in helping you decide upon a program. Your AAOCA can direct you to people to talk with about your options. If you have unanswered questions about a program, find a faculty member with whom you can talk. One of the best times to do this is during Majors' Night at the beginning of each fall and spring semester. Cadet participation in Majors' Night is voluntary and provides a gathering of faculty from all academic departments, ready to discuss their departments' course offerings and the potential benefits their programs offer you.

b. Finally, talk to peers in your squadron. Though "dorm advising" will not provide you with all the information you need to know, it will give you an additional perspective on the programs offered.

8-9. HOW DO I DECLARE A MINOR?

a. You must first declare an academic major before you can declare a minor.

b. You must declare your intention to complete the requirements of a minor as early as possible. First, contact the department administering the minor. After discussing course requirements, meet with your academic advisor. Your academic advisor can add the minor to your academic program via Q2.

c. To earn a minor, you must complete the specific minor's requirements and the requirements for one or more of the divisional, disciplinary, or interdisciplinary majors. Cadets with divisional majors must complete at least 147 semester hours to qualify for a minor. You may earn more than one minor provided the specified criteria are met for each.

8-10. HOW DO I DECLARE AN ACADEMIC MAJOR? To declare a major, meet with your academic advisor and communicate your intentions to declare. Pick up your academic advising folder from your advisor (AAOCA) and deliver it to the secretary or Advisor-in-Charge of the department of your major. Cadets will be assigned an academic advisor from their appropriate academic department, and an entire four year course plan will be registered on-line using Q2.

8-11. WHAT IF I CHOOSE THE "WRONG" MAJOR? After you have completed at least one semester in a major, you should have a better understanding of the major. If you find you have chosen the wrong major, you can change majors or options within the major. A decision to change a major should not be taken lightly; however, do not keep a program that might put your graduation and commissioning in danger. Talk to your advisor before you make a decision. Look at your performance in your current program. Are you doing poorly in the courses because you have difficulty comprehending the subject matter? Are you studying correctly? Remember, even though you want a specific major, your primary goal must be to become an Air Force officer, not an aeronautical engineer.

8-12. HOW CAN I LOSE MY ACADEMIC MAJOR? An ARC or Academy board may direct you to change your major if you are academically deficient. When an ARC or the Academy Board removes you from your major, you have turned your academic program over to them. Often, this happens to cadets who simply choose the wrong major. You will maintain better control of your academic program by making appropriate and timely decisions. The department head responsible for each major may deny that major to a cadet who does not maintain at least a 2.00 major's GPA or who has more than one deficient grade in courses used to determine the major's GPA.

8-13. CAN I GET MY MAJOR BACK ONCE I HAVE LOST IT? If you have previously been denied or removed from a major by a department head, you may again declare the major after obtaining permission from the department head. If you were ARC-directed to change majors, you may again declare your original major with the ARC chairman's approval.

8-14. WHAT IF I CHOOSE TO ENTER A DIVISIONAL MAJOR? After consulting with your

advisor, you may decide that a divisional major is best for you. If the choice to enter into a divisional major was made by you and not the Academic Review Committee, you may reenter a disciplinary major without having to petition the ARC. You must coordinate with the appropriate academic department.

8-15. MULTIPLE MAJORS. While at the Academy, you may earn more than one major. Your diploma will reflect both your primary and secondary major. Your transcript will indicate both majors and minors. Individual courses required in both majors count for both. Cadets with multiple majors must designate a primary major prior to the registration deadline in the fall semester of their first-class year. The following describes multiple majors and their criteria:

a. One Divisional and One Disciplinary: The majors must be in separate divisions. You must complete at least four non-core academic courses (12.0 sem hrs) in residence in excess of the disciplinary major's requirements and must meet all the requirements of the divisional major.

b. Both Disciplinary: You must complete at least four non-core academic courses (12.0 sem hrs) in residence in excess of the primary major's requirements and must meet all requirements of the secondary major.

c. Both Divisional: You must complete at least six non-core academic courses (18.0 sem hrs) in residence in excess of your primary major's requirements and must meet all requirements of the secondary major.

d. More Than Two Majors: You may receive a third or additional major, provided the additional major(s) meet(s) the above criteria.

8-16. HOW DO I DECLARE A DOUBLE MAJOR? To declare a double major, meet first with your current academic advisor to discuss the additional requirements of the second major and how it will impact your academic program. Second, meet with the Advisor-in-Charge of the second major you are declaring. Your academic advisor will ensure the second major is added to your academic program. Cadets pursuing double majors must ensure both majors are listed on the academic program summary.

NOTE: If a discipline has more than one option, you cannot earn a double major in that discipline.

8-17. ACCREDITATION. All graduates are awarded a Bachelor of Science Degree, accredited by the The Higher Learning Commission, The North Central Association of Colleges and Schools. (30 N. LaSalle Street, Suite 2400, Chicago, Illinois 60602-2504, phone (312) 263-0456). All graduates will have BACHELOR OF SCIENCE printed on their diploma. Cadets completing multiple majors will have both appear on their diplomas. For a limited number of disciplines, associated professional bodies have issued professional accreditation. The Accreditation Board for Engineering and Technology (ABET) has accredited majors in Aeronautical Engineering, Astronautical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Engineering Mechanics, Environmental Engineering, and Mechanical

Engineering. The Chemistry, Biochemistry, and Materials Science Options within the Chemistry major are approved by the Committee on Professional Training of the American Chemical Society. The Computer Science major is accredited by the Computing Accrediation Commission of the Accreditation Board for Engineering and Technology. The Management major is accredited by the Association to Advance Collegiate Schools of Business (AACSB). Many disciplines have no professional body that performs the accreditation functions; for those majors, the accreditation by The Higher Learning Commission is the highest possible review.

Figure 8-1
APPROVAL OF DOUBLE MAJOR LETTER

DEPARTMENT OF THE AIR FORCE
OFFICE OF THE REGISTRAR
USAF ACADEMY, COLORADO

Date

MEMORANDUM FOR DFPS (Lt Col Doe) --- Primary Major
(Lt Col Good) --- Secondary Major
IN TURN

FROM:

SUBJECT: Approval of Double Major

1. Request my official transcript reflect both the Political Science and History majors as I will have completed the requirements for both at the end of the spring semester.

2. Political Science is designated as my primary major.

Cadet Signature
Typed Name, C1C, USAF

1st Ind, HQ USAFA/DFPS Date

TO: DFH (Lt Col Good)

I certify Cadet _____ will have completed the requirements for the Political Science major at the completion of his/her program.

Signature Block

2nd Ind, HQ USAFA/DFH Date

TO: DFRR

I certify Cadet _____ will have met the requirements for the History major upon completion of his/her program.

Signature Block

CHAPTER 9

DIVISIONAL MAJORS

MAJOR
Basic Sciences Major
General Engineering Major
Humanities Major
Social Sciences Major

BASIC SCIENCES

THE BASIC SCIENCES MAJOR AT A GLANCE: The Basic Sciences major is a divisional major incorporating the basic sciences of Biology, Chemistry, Computer Science, Mathematical Sciences, and Physics. This divisional program is recommended for cadets who wish to major in the sciences but prefer a broad, flexible curriculum with a high degree of individual choice. This program is also a sensible alternative for cadets 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 the Basic Sciences major lacks the structure of a disciplinary major, cadets 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

If you are undeclared or are in a major outside of the Basic Sciences, contact the Basic Sciences Advisor-in-Charge in DFMS at x3-7100. If you are currently declared with one of the Basic Sciences disciplines, tell your advisor that you would like to change to the Basic Sciences major. Your advisor should then contact the Basic Sciences AIC in order to initiate the change of major request.

COURSE REQUIREMENTS: 141 Semester Hours

A. 91 *Semester hours of Dean's academic core courses.*

B. *5 Semester hours of Director of Athletics courses.*

C. *6 Semester hours of Foreign Language.*

D. *3 Semester hours of Academy Option.*

E. *36 Semester hours of major's courses:*

There are no specific courses mandatory for the Basic Sciences major. This means the cadet has tremendous flexibility in selecting a unique set of courses. Provided the cadet is following a coherent course of study approved by his/her advisor and the Basic Sciences AIC, the cadet is free to pursue practically any avenue of interest in the sciences.

Depth Requirements:

1. At least 18 semester hours at the 300- or 400-level.
2. At least 3 of the 300- or 400-level courses must have formal course prerequisites.
3. Up to six hours of Special Topics (495) courses may be included.

Distribution:

1. Twelve semester hours must be a coherent course of study from any of the

departments within the Basic Sciences Division or in related fields such as operations research, engineering, meteorology, space operations, or materials science.

2. A cadet must also take 15 semester hours of non-core courses from the Basic Sciences Division, composed of one 3 semester hour course from each of the disciplines of: Biology, Chemistry, Computer Science, Mathematical Science, and Physics. Recommended courses from each discipline are listed below.

   a. Biology

Biology 260 – Strategies for Health
Biology 345 – Aerospace Physiology
Biology 380 – Principles of Ecology

   b. Chemistry

Chem 230 – Introductory Organic Chemistry
Chem 325 – Space Chemistry
Chem 350 – Chemistry of Weapons
Chem 381 – Environmental Chemistry

   c. Computer Science

Comp Sci 211 – Programming for Scientist and Engineers
Comp Sci 310 – Information Technology
Comp Sci 315 – Web Design and Construction

   d. Mathematical Sciences

Math 243 – Calculus III (or Math 253)
Math 245 – Differential Equation
Math 310 – Mathematical Modeling
Math 359 – Design and Analysis of Experiments

   e. Physics

Physics 310 – Principles of Nuclear Engineering
Physics 315 – Combat Aviation Physics
Physics 370 – Upper Atmospheric and Geo-Space Physics
Physics 371 – Astronomy
Meteor 320 – Introduction to Atmospheric Science

NOTE: A course may not be counted toward both distribution requirements.

SUGGESTED COURSE SEQUENCE

Basic Science Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Chem 141	3	2	Basic Sci Option #1	3	1	Basic Sci Option #4	3	1	Basic Sci Option #7	3	1
	Math 141	3	1	Basic Sci Option #2	3	1	Basic Sci Option #5	3	1	Basic Sci Option #8	3	1
Fall	**Engr 100**	3	1	**Soc Sci 112**	3	1	**Energy/Systems Option**	3	1	Open Option #1	3	1
	English 111	3	1	**Beh Sci 110**	3	1	**Math 300**	3	1	**Beh Sci 310**	3	1
	Comp Sci 110	3	1	**Physics 215**	3	2	**El Engr 215**	3	1	**Astro Engr 310**	3	1
				Foreign Lang I	3	2	**Mgt 200**	2	1	**English 411**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2	*Phy Ed*	1	2
		15.5	8		19	10		17.5	8		19	8
	Chem 142	3	2	Basic Sci Option #3	3	1	Basic Sci Option #6	3	1	Basic Sci Option #9	3	1
	Math 142	3	1	**English 211**	3	1	**Pol Sci 311**	3	1	Open Option #2	3	1
Spring	**History 101**	3	1	**Biology 215**	3	2	**Aero Engr 315**	3	1	Open Option #3	3	1
	Engr Mech 120	3	1	**Civ Engr 210**	3	1	**Law 220**	3	1	***Academy Option***	3	1
	MSS 100	3	1	**History 202**	3	1	**Philos 310**	3	1	**MSS 400**	3	1
	Physics 110	3	2	**Foreign Lang II**	3	2	**Econ 200**	2	1	*Phy Ed*	0.5	2
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2			
		18.5	10		18.5	10		17.5	8		15.5	7

Course Unit Summary
Core (31)
Major (12)
Academy Option (1)
Foreign Lang (2)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	36.0	"
Academy Option =	3.0	"
Foreign Languages=	6.0	"
Phy Ed =	5.0	"
Total =	**141.0**	"

GENERAL ENGINEERING

THE GENERAL ENGINEERING MAJOR AT A GLANCE: The General Engineering major is a divisional major incorporating the engineering disciplines of Aeronautical, Astronautical, Civil, Electrical, Environmental, and Engineering Mechanics. This divisional program is recommended for cadets 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 cadets already declared in an Engineering disciplinary major who for a variety of reasons find the divisional approach more suited to fulfilling graduation requirements.

The USAFA 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 usually is necessary before acceptance into a graduate program.

The curriculum at USAFA provides cadets the maximum flexibility to selectively structure their academic program to individual preferences. The program, however, is not accredited under the Accreditation Board for Engineering and Technology (ABET). A Bachelor of Science degree in General Engineering is awarded upon completion of all requirements listed below.

If you are undeclared or are in a major outside of the Engineering Division, contact the General Engineering Advisor-in-Charge in DFCE at 3-3150. If you are currently declared with one of the Engineering Division disciplines, tell your advisor that you would like to change to the General Engineering major. Your advisor should then contact the General Engineering AIC in order to initiate the change of major request.

COURSE REQUIREMENTS: 141 Semester Hours

A. 91 *Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
El Engr 231	Electrical Circuits and Systems I	El Engr 215
Math 356	Probability and Statistics for Engineers and Scientists	Math 300
Aero 241, Engr 311, or Mech Engr 312	Aero-Thermodynamics, Electrical Power Systems, or Thermal Fluids Engineering I	Energy/System Option

B. *5 Semester hours of Director of Athletics courses.*

C. *6 Semester hours of Foreign Language.*

D. *3 Semester hours of Academy Option.*

E. *36 Semester hours of major's courses:*

1. Engr Option (Engr Options may be from the same or different depts)
2. Engr Option
3. Engr Option
4. Engr Option
5. Engr Option
6. Engr Option
7. Engr Option
8. Engr Option
9. Engr/Bas Sci Option (See Supplemental Information)
10. Engr/Bas Sci Option (See Supplemental Information)
11. Math 243 (or Math 253)/Math 340
12. Math 245

Supplemental Information:

1. An Engineering Option is any course taught by the Engineering Division not used to satisfy any other requirement. There is no required distribution of courses from each department.

2. The Engineering/Basic Science Option is any course not used to satisfy any other curriculum requirement taught by the Basic Science or Engineering Divisions. Additionally, Geography 353 (Geomorphology), Geography 360 (Environmental Geography), and Geography 382 (Remote Sensing and Imagery Analysis) may be used to satisfy this option.

3. One year of foreign language is required for the General Engineering program.

SUGGESTED COURSE SEQUENCE

General Engineering Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Chem 141	3	2	Math 243	3	1	Engineering Option #3	3	1	Engineering Option #5	3	1
	History 101	3	1	**Physics 215**	3	2	Engineering Option #4	3	1	**Beh Sci 310**	3	1
Fall	**English 111**	3	1	**Engr Mech 120**	3	1	Engr/Bas Sci Opt #1	3	1	**Astro Engr 310**	3	1
	Math 141	3	1	**English 211**	3	1	**Pol Sci 311**	3	1	**Energy/Systems Option**	3	1
	Engr 100	3	1	**Biology 215**	3	2	**Aero Engr 315**	3	1	**English 411**	3	1
				Soc Sci 112	3	1	**Foreign Lang I**	3	2	*Phy Ed*	0.5	2
	Phy Ed	0.5	2	*Phy Ed*	1	2	*Phy Ed*	1	2			
		15.5	8		19	10		19	9		15.5	7
	Physics 110	3	2	Engineering Option #1	3	1	Engr/Bas Sci Opt #2	3	1	Engineering Option #6	3	1
	Chem 142	3	2	Engineering Option #2	3	1	**Math 300/356**	3	1	Engineering Option #7	3	1
Spring	**Math 142**	3	1	Math 245	3	1	**Law 220**	3	1	Engineering Option #8	3	1
	Comp Sci 110	3	1	**History 202**	3	1	**El Engr 215/231**	3	1	***Academy Option***	3	1
	Beh Sci 110	3	1	**Mg 200**	2	1	**Philos 310**	3	1	**MSS 400**	3	1
	MSS 100	3	1	**Econ 200**	2	1	**Foreign Lang II**	3	2	*Phy Ed*	0.5	2
	Phy Ed	0.5	2	**Civ Engr 210**	3	1	*Phy Ed*	0.5	2			
				Phy Ed	0.5	2						
		18.5	10		19.5	9		18.5	9		15.5	7

Course Unit Summary
Core (31)
Major (12)
Academy Option (1)
Foreign Lang (2)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	36.0	"
Academy Option =	3.0	"
Foreign Languages=	6.0	"
Phy Ed =	5.0	"
Total =	**141.0**	"

HUMANITIES

THE HUMANITIES MAJOR AT A GLANCE: 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, 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 cadets for graduate study and for a wide variety of career fields.

COURSE REQUIREMENTS: 141 Semester Hours

A. 91 *Semester hours of Dean's academic core courses to include the following core alternate:*

Core Alternate		**Substitutes for**
Geog 310	Geospatial Information Analysis	System Option

B. *5 Semester hours of Director of Athletics courses.*

C. *12 Semester hours of Foreign Language.*

D. *3 Semester hours of Academy Option.*

E. *30 Semester hours of major's courses:*

1. *English Option*. Choose any literature course taught by DFENG and which the prerequisites have been met.

2. *Fine Arts Option*. Fine Art 451, 452, or Fine Art 458.

3. *History Option*. Choose any 300- or 400-level course offered by DFH.

4. *Philosophy Requirement*. Philos 390: Great Philosophers.

5-10. *Humanities Divisional Options*. Choose six courses offered by the Humanities Division and the departments within the division.

SUGGESTED COURSE SEQUENCE

Humanities Major

4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
Chem 141	3	2	**Physics 110**	3	2	English Option	3	1	Divisional Option	3	1
Comp Sci 110	3	1	**Beh Sci 110**	3	1	Fine Art Option	3	1	Divisional Option	3	1
English 111	3	1	**English 211**	3	1	**Philos 310**	3	1	Divisional Option	3	1
Math 141	3	1	**Engr 100**	3	1	**El Engr 215**	3	1	**Beh Sci 310**	3	1
For Lang I	3	2	**Pol Sci 311**	3	1	**Biology 215**	3	2	**Astro Engr 310**	3	1
Phy Ed	0.5	2	**For Lang III**	3	1	**Civ Engr 210**	3	1	**Geog 310**	3	1
			Phy Ed	1	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
	15.5	9		19	9		19	9		18.5	8
History 101	3	1	**History 202**	3	1	Philos 390	3	1	Divisional Option	3	1
Chem 142	3	2	**Mgt 200**	2	1	History Option	3	1	Divisional Option	3	1
Math 142	3	1	**Econ 200**	2	1	Divisional Option	3	1	***Academy Option***	3	1
Soc Sci 110	3	1	**Law 220**	3	1	**Math 300**	3	1	**Aero Engr 315**	3	1
MSS 100	3	1	**Engr Mech 120**	3	1	**English 411**	3	1	**MSS 400**	3	1
For Lang II	3	2	**Physic 215**	3	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
Phy Ed	0.5	2	**For Lang IV**	3	1						
			Phy Ed	0.5	2						
	18.5	10		19.5	10		15.5	7		15.5	7

Course Unit Summary
Core (31)
Major (10)
Academy Option (1)
Foreign Lang (4)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	30.0	"
Academy Option =	3.0	"
Foreign Languages=	12.0	"
Phy Ed =	5.0	"
Total =	**141.0**	"

SOCIAL SCIENCES

THE SOCIAL SCIENCES MAJOR AT A GLANCE: 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, Geography, 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 cadet 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, as indicated below, in Economics, Management, Law, Political Science, and Behavioral Sciences. More concentrated study in one discipline is possible through the use of the 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 graduate degree in a particular discipline would be an option after graduation.

COURSE REQUIREMENTS: 141 Semester hours

A. 91 *Semester hours of Dean's academic core courses.*

B. *5 Semester hours of Director of Athletics courses.*

C. *6 Semester hours of Foreign Languages.*

D. *3 Semester hours of Academy Option.*

E. *36 Semester hours of additional major's courses:*

1. Social Sciences Breadth Elective #1 (any non-core Econ course)
2. Social Sciences Breadth Elective #2 (any non-core Beh Sci course)
3. Social Sciences Breadth Elective #3 (any non-core Law course)
4. Social Sciences Breadth Elective #4 (any non-core Mgt course)
5. Social Sciences Breadth Elective #5 (any non-core Pol Sci course)
6. Social Sciences Depth Elective #1
7. Social Sciences Depth Elective #2
8. Social Sciences Depth Elective #3
9. Social Sciences Depth Elective #4
10. Social Sciences Depth Elective #5
11. Social Sciences Depth Elective #6

(Depth Electives: Select any six non-core courses from any department within the Social Sciences division or from Military Strategic Studies in any combination or concentration)

12. Academy Option

Supplemental Information:

1. Mgt 423 (Managerial Economics), taught by DFEG, may satisfy either a Mgt or Econ requirement.

2. Soc Sci 401 (Creativity), taught by DFBL, may satisfy a Beh Sci requirement.

3. Soc Sci 420 (Law and Economics), taught by DFEG and DFL, may satisfy either a Law or Econ requirement

4. Soc Sci 483 (Negotiation and Mediation Processes), taught by DFL, DFM, and DFBL, may satisfy wither a Beh Sci, Law, or Mgt requirement.

5. Pol Sci 423 (War Crimes, Genocide, and Human Rights), taught by DFPS, DFH, and DFL, may satisfy either a Pol Sci or Law requirement.

6. Pol Sci 465 (US National Space Policy and Law), taught by DFPS and DFL, may satisfy either a Pol Sci or Law requirement.

Course -- may satisfy Soc Sci breadth elective for either/or

	Econ	Beh Sci	Law	Mgt	Pol Sci
Mgt 423	X			X	
Soc Sci 401		X			
Soc Sci 420	X		X		
Soc Sci 483		X	X	X	
Pol Sci 423			X		X
Pol Sci 465			X		X

7. Any ForArStu course may satisfy one social science depth elective

SUGGESTED COURSE SEQUENCE

Social Sciences Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Math 141	3	1	**Engr Mech 120**	3	1	Divisional Breadth	3	1	Divisional Breadth	3	1
	Chem 141	3	2	**English 211**	3	1	Divisional Breadth	3	1	Divisional Depth	3	1
Spring	**English 111**	3	1	**History 101**	3	1	**Aero Engr 315**	3	1	Divisional Depth	3	1
	Engr 100	3	1	**Physics 110**	3	2	**Systems Option**	3	1	**Beh Sci 310**	3	1
	Foreign Lang I	3	2	**Econ 200**	2	1	**Pol Sci 311**	3	1	**Astro Engr 310**	3	1
	Phy Ed	0.5	2	**Mgt 200**	2	1	*Phy Ed*	1	2	*Phy Ed*	0.5	2
				Beh Sci 110	3	1						
				Phy Ed	0.5	2						
		15.5	9		19.5	10		16	7		15.5	7
	Math 142	3	1	**Biology 215**	3	2	Divisional Breadth	3	1	Divisional Breadth	3	1
Fall	**Chem 142**	3	2	**Civ Engr 210**	3	1	Divisional Depth	3	1	Divisional Depth	3	1
	Soc Sci 112	3	1	**El Engr 215**	3	1	Divisional Depth	3	1	Academic Div Option	3	1
	Comp Sci 110	3	1	**Law 220**	3	1	Divisional Depth	3	1	***Academy Option***	3	2
	MSS 100	3	1	**History 202**	3	1	**Philos 310**	3	1	**English 411**	3	1
	Foreign Lang II	3	2	**Physics 215**	3	2	**Math 300**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
		18.5	10		18.5	10		19	6		18.5	9

Course Unit Summary
Core (31)
Major (12)
Academy Option (1)
Foreign Language (2)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	36.0	"
Academy Option =	3.0	"
Foreign Language =	6.0	"
Phy Ed =	5.0	"
Total =	**141.0**	"

CHAPTER 10

DISCIPLINARY AND INTERDISCIPLINARY MAJORS AND MINORS

MAJOR/MINOR
Aeronautical Engineering
Astronautical Engineering
Behavioral Science
Biology
Chemistry
Civil Engineering
Computer Engineering
Computer Science
Economics
Electrical Engineering
Engineering Mechanics
English
Environmental Engineering
Foreign Area Studies
Foreign Language Minor
Geography
History
Legal Studies
Management
Mathematical Sciences
Mechanical Engineering
Meteorology
Military Strategic Studies
Operations Research
Philosophy Minor
Physics
Political Science
Space Operations
Systems Engineering
Systems Engineering Management

AERONAUTICAL ENGINEERING

THE AERONAUTICAL ENGINEERING MAJOR AT A GLANCE: 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 Engineering Accreditation Commission of the Accreditation Board accredits this degree for Engineering and Technology.

Program Operational Goals define attributes and capabilities young graduates of the USAFA Aeronautical Engineering Program are expected to exhibit.

The Aeronautical Engineering Program Operational Goals seek to prepare cadets to become Air Force Officers who:

- Possess breadth of integrated, fundamental knowledge in engineering, basic sciences, social sciences, and 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, and
- Know and practice their ethical, professional, and community responsibilities as embodied in the United States Air Force Core Values.

The following Program Curricular Outcomes describe capabilities that cadets must demonstrate in order to earn a Bachelor of Science degree in Aeronautical Engineering at USAFA.

Cadets satisfactorily completing the USAFA Aeronautical Engineering program will have shown that they can:

- Use fundamental knowledge to solve aeronautical engineering problems commensurate with a Bachelor of Science degree,
- Plan and execute experimental and computational investigations, and interpret and analyze data from such investigations to formulate sound conclusions,
- Develop and evaluate engineering designs that meet customer needs,
- Use speaking and writing skills to communicate effectively,
- Work effectively as a member of a multidisciplinary team, and
- Demonstrate the 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.

Interested cadets are required to declare the Aeronautical Engineering major no later than the registration deadline in their third semester. However, late declarations or transfers to this major

may be allowed at the beginning of the 2nd class year provided cadets have completed the following courses before enrolling: Math 243 (or Math 253), Math 245, Physics 215, Aero Engr 241, Aero Engr 315 and El Engr 231. Cadets interested in the Aeronautical Engineering major are encouraged to discuss issues and concerns with an academic advisor or the Department of Aeronautics Advisor-In-Charge.

COURSE REQUIREMENTS: 147 Semester Hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
Aero Engr 241	Aero-Thermodynamics	Systems Option
Math 356	Probability and Statistics for Engineers and Scientists	Math 300
El Engr 231	Electrical Circuits and Systems I	El Engr 215

B. *5 Semester hours of Director of Athletics core courses.*

C. *3 Semester hours of Academy Option.*

D. *No Foreign Language courses required.*

E. *48 Semester hours of major's courses:*

1. Math 243 (or Math 253) Calculus III (or Advanced Placed Calculus III)
2. Math 245 Differential Equations
3. Math 346 Engineering Math
4. Engr Mech 320 Dynamics
5. Engr Mech 330 Mechanics of Deformable Bodies
6. Aero Engr 341 Aeronautical Fluid Mechanics
7. Aero Engr 342 Computational Aerodynamics
8. Aero Engr 351 Aircraft Performance and Static Stability
9. Aero Engr 352 Aircraft Dynamic Stability and Control
10. Aero Engr 361 Propulsion I
11. Structures and Materials Elective (select one from the five courses listed below)
    a. Engr Mech 332 Analysis and Design of Aerospace Structure
    b. Engr Mech 350 Mechanical Behavior of Materials (recommended for cadets in the propulsion track)
    c. Engr Mech 431 Introduction to Finite Element Analysis
    d. Aero Engr 436 Aeroelasticity
    e. Engr Mech 450 Aerospace Composite Materials
12. Aero Engr 442 Advanced Aerodynamics
13. Aero Engr 471 Aeronautics Laboratory
14. Aero Engr Elective (See Supplemental Information 1)
15. Aero Engr 481 Intro to Aircraft and Propulsion System Design
16. Design Elective (select one from the two courses listed below)
    a. Aero Engr 482 Aircraft Design
    b. Aero Engr 483 Aircraft Engine Design

Supplemental Information:

1. The Aero Engr Elective must come from the list of courses below and must not have been used previously to satisfy the Structures and Materials or Design electives: (electives are offered based on need and availability – check with your advisor for details)

Aero Engr 436	Aeroelasticity
Aero Engr 446	Introduction to Hypersonics
Aero Engr 447	Advanced Applied Aerodynamics
Aero Engr 456	Flight Test Techniques (dept permission req)
Aero Engr 457	Aircraft Feedback Control Systems
Aero Engr 466	Propulsion II (required for cadets in the propulsion track)
Mech Engr 467	Energy Conversion
Aero Engr 482	Aircraft Design
Aero Engr 483	Aircraft Engine Design
Engr Mech 431	Introduction to Finite Element Analysis
Engr Mech 432	Finite Element Analysis
Engr Mech 450	Aerospace Composite Materials
Aero Engr 495	Special Topics (3 sem hrs only, dept permission req)
Aero Engr 499	Independent Study (3 sem hrs only, dept permission req)

Other Engineering or Basic Science courses with dept permission.

SUGGESTED COURSE SEQUENCE

Aeronautical Engineering Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
Fall	**Chem 141**	3	2	Math 243	3	1	Aero Engr 341	3	1	Aero Engr 442	3	1
	Beh Sci 110	3	1	**Aero Engr 315**	3	1	Aero Engr 351	3	1	Aero Engr 481	3	2
	MSS 100	3	1	**English 211**	3	1	Math 346	3	1	Aero Engr 471	3	2
	Math 141	3	1	**History 202**	3	1	Engr Mech 320	3	2	Aero Elective	3	1
	Engr 100	3	1	**Physics 110**	3	2	**Civ Engr 210**	3	1	Structures Elective	3	1
				Mgt 200	2	1	**Beh Sci 310**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	**Econ 200**	2	1	*Phy Ed*	1	2	*Phy Ed*	0.5	2
				Phy Ed	1	2						
		15.5	8		20	10		19	9		18.5	10
Spring	**History 101**	3	1	Math 245	3	1	Aero Engr 342	3	2	Design Elective	3	2
	Chem 142	3	2	**Aero Engr 241**	3	1	Aero Engr 352	3	1	***Academy Option***	3	1
	Math 142	3	1	**El Engr 231**	3	1	Aero Engr 361	3	1	**Astro Engr 310**	3	1
	Comp Sci 110	3	1	**Physics 215**	3	2	Engr Mech 330	3	1	**English 411**	3	1
	Engr Mech 120	3	1	**Biology 215**	3	2	**Math 356**	3	1	**Philos 310**	3	1
	English 111	3	1	**Soc Sci 112**	3	1	**Law 220**	3	1	**Pol Sci 311**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		18.5	9		18.5	10		18.5	9		18.5	9

Course Unit Summary
Core (31)
Major (16)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

ASTRONAUTICAL ENGINEERING

THE ASTRONAUTICAL ENGINEERING MAJOR AT A GLANCE: The 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 cadet is prepared for Air Force duty with specialization in research, design, development and analysis of space technology and aerospace avionics. Cadets who successfully complete this major are awarded the degree of Bachelor of Science in Astronautical Engineering, which is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

Interested cadets should declare the Astronautical Engineering major no later than the registration deadline in their second semester. However, in the event that you are late declaring the Astronautical Engineering major, you must discuss the transfer with an academic advisor from the Department of Astronautics. In any event, the course outline shown herein reflects the sequence of required major's courses that you must take. Please see an academic advisor or the Department of Astronautics Advisor-In-Charge to establish your specific course sequence.

The goals of the Astronautical Engineering Program are to prepare cadets to become Air Force Officers who:

- Possess a fundamental knowledge in astronautical engineering,
- Can communicate effectively,
- Work effectively with others,
- 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, and
- Know their ethical and professional responsibilities as embodied in the United States Air Force core values.

The *Program Operational Goals* above describe what the Air Force would like to see in our graduates as they begin their careers as Air Force Engineering Officers. To best support these goals our program's curriculum is designed such that, by graduation, our graduates possess certain qualities or outcomes. These *Program Curricular Outcomes* are listed below. Upon successful completion of the Academy program in Astronautical Engineering, cadets will have the ability to:

- Use fundamental knowledge of orbital mechanics, space environment, attitude control, telecommunications, space structures and rocket propulsion to solve astronautical engineering problems,
- 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 format,
- 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 skills needed to engage in life-long learning, and
- Informatively discuss the impact of engineering on present-day societal and global contemporary issues to include Air Force Aerospace capabilities and requirements.

COURSE REQUIREMENTS: 148 Semester Hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
Aero Engr 241	Aero-Thermodynamics	Systems Option
Math 356	Probability and Statistics for Engineers and Scientists	Math 300
El Engr 231	Electrical Circuits and Systems I	El Engr 215

B. *5 Semester hours of Director of Athletics courses.*

C. *3 Semester hours of Academy Option.*

D. *No Foreign Language courses required.*

E. *49 Semester hours of major's courses:*

1. Math 243 (or Math 253)	Calculus III (or Advanced Placed Calculus III)
2. Math 245	Differential Equations
3. Math 346	Engineering Math
4. Engr Mech 320	Dynamics
or Physics 355 (F)	Classical Mechanics
5. Engr Mech 330	Mechanics of Deformable Bodies
6. Engr 341 (F)	Linear Systems Analysis and Design
7. Engr 342 (S)	Linear Control System Analysis and Design
8. Astro 201	Technology Skills for Astronautics (See Supplemental Information 1)
9. Astro Engr 321	Astrodynamics
10. Astro Engr 331 (F)	Space Vehicle Systems Design I
11. Astro Engr 351	Rocket Propulsion
12. Elec Engr 447	Communications Systems I
13. Astro Engr 445	Spacecraft Attitude Dynamics and Control
14./15. Applied Astro Option 1 &2	(See Supplemental Information 2)
16. Astro Depth Option	(See Supplemental Information 3)
17. Space Environment Option	(See Supplemental Information 4)

Supplemental Information:

1. Astronautical Engineering majors may take Comp Sci 211 in lieu of Astro Engr 201.

2. Applied Astro Options:
   (Choose one combination of the following Courses)
   a. Astro Engr 436 (F) Small Spacecraft Engineering I
      Astro Engr 437 (S) Small Spacecraft Engineering II

   b. Astro Engr 452 (F) Rocket Engineering I
      Astro Engr 453 (S) Rocket Engineering II

   c. Astro Engr 431 Aerospace Systems Engineering Design plus either
      Astro Engr 423 (F) Space Mission Design or
      Astro Engr 443 (F) Digital Control Theory and Design

3. Astro Depth Option:
   (Choose 1 of the following courses not used to fulfill another requirement)
   Astro Engr 422 (S) Advanced Astrodynamics
   Astro Engr 423 (F) Space Mission Design
   Astro Engr 443 (F) Digital Control Theory and Design
   Astro Engr 444 (S) Modern Control Theory
   Astro Engr 446 (S) Space Navigation
   Astro Engr 543 (S) Methods of Optimization for Engineers

4. Space Environment Option:
   Biology 350 (S) Biology and Space Exploration
   Chem 325 (S) Space Chemistry
   Physics 370 (S) Upper Atmospheric and Geo-Space Physics

5. Academy Option:
   Cadets who are not using this option for basic preparatory courses, airmanship or aviation courses are strongly encouraged to fill it with Comp Sci 211 or another course from the Astro Department Option list.

SUGGESTED COURSE SEQUENCE

Astronautical Engineering Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Math 141	3	1	Math 243	3	1	Math 346	3	1	El Engr 447	3	1
	Chem 141	3	2	**Soc Sci 112**	3	1	Astro Engr 321	3	1	Astro Engr 445	3	1
Fall	**History 101**	3	1	**Biology 215**	3	2	Engr 341	3	1	Applied Astro Option 1	3	1
	English 111	3	1	**Physics 215**	3	2	Engr Mech 330	3	1	**Beh Sci 310**	3	1
	Beh Sci 110	3	1	**Engr Mech 120**	3	1	**Aero Engr 315**	3	1	**English 411**	3	1
				El Engr 231	3	1	**Law 220**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
		15.5	8		19	10		19	8		18.5	8
	Math 142	3	1	Math 245	3	1	Astro Engr 331	3	2	Astro Depth Option	3	1
	Comp Sci 110	3	1	Astro Engr 201	1	1	Astro Engr 351	3	1	Space Environ Option	3	1
Spring	**Engr 100**	3	1	Engr Mech 320	3	2	Engr 342	3	1	Applied Astro Option 2	3	1
	Physics 110	3	2	**History 202**	3	1	**Econ 200**	2	1	***Academy Option***	3	1
	Chem 142	3	2	**Aero Engr 241**	3	2	**Mgt 200**	2	1	**Philos 310**	3	1
	MSS 100	3	1	**Astro Engr 310**	3	1	**Math 356**	3	1	**Pol Sci 311**	3	1
	Phy Ed	0.5	2	**English 211**	3	1	**Civ Engr 210**	3	1	*Phy Ed*	0.5	2
				Phy Ed	0.5	2	*Phy Ed*	0.5	2			
		18.5	10		19.5	0.1		19.5	10		18.5	8

Course Unit Summary
Core (31)
Major (17)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core	**91.0**	Sem Hours
Major =	49.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**148.0**	"

NOTES:

1. Astro Engr 445 must be taken in the Fall semester if Astro Engr 446 is chosen as an Astro Depth option
2. All majors going on to graduate school are highly encouraged to take Astro Engr 543 as an Astro Depth option or as an additional course.

BEHAVIORAL SCIENCES

THE BEHAVIORAL SCIENCES MAJOR AT A GLANCE: 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 tracks are offered in the major: Leadership and Organizations Track, which examines in depth the area of leadership; Human Factors and Systems Design Track, which focuses on how people interact with the machines and systems they use; and the Behavioral Sciences Track, which allows students the opportunity to choose courses of the greatest interest. Each track emphasizes understanding people, but in different contexts

REQUIRED COURSES: 147 Semester Hours

A. 91 *Semester hours of Dean's academic core courses.*

B. *5 Semester hours of Director of Athletics courses.*

C. *12 Semester hours of Foreign Language.*

D. *3 Semester Hours of Academy Option.*

E. *36 Semester hours of major's courses:*

1. Beh Sci 331 Basic Research Design and Statistics
2. Beh Sci 332 Advanced Research Design and Statistical Tools

Required Courses for Behavioral Sciences Majors – Behavioral Sciences Option:

The Behavioral Sciences Option requires the completion of the core plus 12 major's courses for a total of 147 semester hours. This option allows cadets to tailor an array of courses within the behavioral sciences, from a micro to a macro level. In addition to the previous two courses, all Behavioral Sciences Option majors will be required to take:

From the attached table: 1 choice within each of the three 300-level breadth options (total of 3 courses), 3 choices from the 400-level breadth courses, 2 choices from any breadth course, and 2 column options.

Required Courses for Behavioral Sciences Majors – Leadership and Organizations Option:

The Leadership and Organizations Option requires the completion of the core plus 12 major's courses for a total of 147 semester hours. This option allows cadets an opportunity to examine in depth the area of leadership. In addition to the previous two courses, all Leadership and Organizations Option majors must take:

Beh Sci 352 Social Psychology
Beh Sci 360 Sociology

Beh Sci 377 Industrial-Organizational Psychology
Beh Sci 380 Personality
Beh Sci 410 Advanced Topics in Leadership
From the attached table: 1 choice from the 300-level Experimental, 2 breadth choices (any 400-level and all 300-level except Social-Cultural), and 2 column options.

Required Courses for Behavioral Sciences Majors - Human Factors and Systems Design Option:

The Human Factors and System Design Option requires the completion of the core plus 12 major's courses for a total of 147 semester hours. In addition to the previous two courses, all Human Factors and Systems Design Option majors must take:

Beh Sci 335 Learning and Memory
Beh Sci 370 Cognitive Psychology
Beh Sci 371 Aviation Psychology
Beh Sci 373 Introduction to Human Factors
Beh Sci 375 Human Factors in System Failure
Beh Sci 471 Engineering Psychology (or HF-related Beh Sci 499)
Beh Sci 472 Human Computer Interaction
Beh Sci 473 Human Factors in Systems Design
From the attached table: 2 column choices

Behavioral Sciences Options Table

		Behavioral Sciences	Leadership & Organizations	Human Factors & Systems Design
		Bolded courses required	***Bolded courses required***	***Bolded courses required***
Required for all options:		**Beh Sci 331 Res Method/Stats** **Beh Sci 332 Adv Res Methods**	**Beh Sci 331 Res Method/Stats** **Beh Sci 332 Adv Res Methods**	**Beh Sci 331 Res Method/Stats** **Beh Sci 332 Adv Res Methods**
		Choose one course <u>from each</u> 300-level breadth	***Choose one course from 300-level Experimental***	
300-level Breadth	**Experimental**	335 Learning & Memory 355 Biopsychology 370 Cognitive Psychology 390 Sensation and Perception	335 Learning & Memory 355 Biopsychology 370 Cognitive Psychology 390 Sensation and Perception	**335 Learning & Memory** 355 Biopsychology **370 Cognitive Psychology** 390 Sensation and Perception
300-level Breadth	**Individual Development**	320 Lifespan Development 330 Abnormal Psychology 380 Personality	320 Lifespan Development 330 Abnormal Psychology **380 Personality**	320 Lifespan Development 330 Abnormal Psychology 380 Personality
300-level Breadth	**Social-Cultural**	350 Cultural Anthropology 352 Social Psychology 360 Sociology 377 Indust/Org Psychology	350 Cultural Anthropology **352 Social Psychology** **360 Sociology** **377 Indust/Org Psychology**	350 Cultural Anthropology 352 Social Psychology 360 Sociology 377 Indust/Org Psychology
		Choose <u>any 3</u> from these 400-level courses		
400-level	**Fixed**	410 Advanced Leadership 430 Tests & Measurement 490 Counseling	**410 Advanced Leadership** 430 Tests & Measurement 490 Counseling	410 Advanced Leadership 430 Tests & Measurement 490 Counseling
400-level	**Varies by Semester**	460 Adv Topics Sociol/Anthro 470 Adv Topics Cog/Bio-Psych 480 Adv Topics Pers/Soc Psych 495 Special Topics 499 Independent Study[1]	460 Adv Topics Sociol/Anthro 470 Adv Topics Cog/Bio-Psych 480 Adv Topics Pers/Soc Psych 495 Special Topics 499 Independent Study[1]	460 Adv Topics Sociol/Anthro 470 Adv Topics Cog/Bio-Psych 480 Adv Topics Pers/Soc Psych 495 Special Topics 499 Independent Study[1 *]
		Choose any 2 additional courses (above)	***Choose any 2 additional courses above <u>except</u> 300-level Social-Cultural***	
		Choose any 2 additional courses from this column (above or below)	***Choose 2 additional courses from this column (above or below)***	***Choose 2 additional courses from this column (above or below)***
Human Factors		371 Aviation Psychology 373 Intro to HF 375 HF in Systems Error 471 Engineering Psych 472 Human-Computer Interact 473 HF Capstone	371 Aviation Psychology 373 Intro to HF 375 HF in Systems Error 471 Engineering Psych 472 Human-Computer Interact 473 HF Capstone	**371 Aviation Psychology** **373 Intro to HF** **375 HF in Systems Error** **471 Engineering Psych** **472 Human-Computer Interact** **473 HF Capstone** *
DFBL Options		340 Marriage & Family 385 Sport Psych Soc Sci 401 Creativity Soc Sci 483 Negotiation	340 Marriage & Family 385 Sport Psych Soc Sci 401 Creativity Soc Sci 483 Negotiation	340 Marriage & Family 385 Sport Psych Soc Sci 401 Creativity Soc Sci 483 Negotiation
Special Interest		Eng 367 Lit of Am Minorities Geog 350 Human Geog Philos 330 Phil of Science Others approved by DFBL	Mgt 303 Mgt Intro Mgt 361 Human Mgl Systems II Mgt 446 Organizational Theory MSS 463 Innovation/Officership MSS 466 Contemp Issues Philos 311 War, Moral, Mil Prof His 483 Great Americans Poli Sci 451 Am Pol Thought Poli Sci 423 War Crimes, Genocide, and Human Rights Others approved by DFBL	Biology 320 Biomechanics Biology 345 Aerospace Phys Others approved by DFBL

[1]*Min. GPA requirement. Highly encouraged for cadets interested in pursuing graduate school.*
[*]*HF option majors may substitute Beh Sci 499 for Beh Sci 473 with departmental approval.*

SUGGESTED COURSE SEQUENCE

Behavioral Sciences Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
Fall	**Chem 141**	3	2	**Civ Engr 210**	3	1	Beh Sci 331	3	2	Beh Sci Track	3	1
	Comp Sci 110	3	1	**Physics 110**	3	2	Beh Sci Track	3	1	Beh Sci Track	3	1
	English 111	3	1	**Soc Sci 112**	3	1	Beh Sci Track	3	1	Beh Sci Track	3	1
	Math 141	3	1	**MSS 100**	3	1	**Math 300**	3	1	**Philos 310**	3	1
	Foreign Lang I	3	2	**Engr Mech 120**	3	1	**Biology 215**	3	2	**Astro Engr 310**	3	1
				Foreign Lang III	3	1	**Pol Sci 311**	3	1	**English 411**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
		15.5	9		19	9		19	10		18.5	8
Spring	**Chem 142**	3	2	**Law 220**	3	1	Beh Sci 332	3	2	Beh Sci Track	3	1
	Math 142	3	1	**English 211**	3	1	Beh Sci Track	3	1	Beh Sci Track	3	1
	Engr 100	3	1	**Physics 215**	3	2	Beh Sci Track	3	1	Beh Sci Track	3	1
	Beh Sci 110	3	1	**Mgt 200**	2	1	**Beh Sci 310**	3	1	***Academy Option***	3	1
	History 101	3	1	**Econ 200**	2	1	**History 202**	3	1	**Energy/Syst Option**	3	1
	Foreign Lang II	3	2	**El Engr 215**	3	1	**Aero Engr 315**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	**Foreign Lang IV**	3	1	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
				Phy Ed	0.5	2						
		18.5	10		19.5	10		18.5	9		18.5	8

Course Unit Summary
Core (31)
Major (12)
Foreign Language (4)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	36.0	"
Foreign Language =	12.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

BIOLOGY

THE BIOLOGY MAJOR AT A GLANCE: 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 cadet'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 cadets 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; cadets 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 Corp (including aerospace physiology, bioenvironmental engineering, health physics, and physical therapy). Contact the Health Professions or BSC Advisor in the Department of Biology for more information.

The Department of Biology (DFB) strongly urges all cadets considering the Biology major to enroll in Biology 215 by fall semester of the third-class year. This will allow for a more balanced scheduling of upper-level courses. However, if you are transferring into the Biology major from another major, you can still complete a Biology major in two years. See a Biology academic advisor for suggested course sequence. Note: Biology 215 may be validated if a cadet has received a 4 or 5 on the AP Biology Exam or a 6 or 7 on the IB Biology Exam, or has previously taken the equivalent of Biology 215 at another college and received a B or better in the course(s). See the Biology AIC for additional information on Biology 215 validation.

COURSE REQUIREMENTS: 147 Semester hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternate:*

Required Core Alternate		Substitutes for
Geog 310	Geospatial Information Analysis	Systems Option

B. *5 Semester hours of Director of Athletics courses.*

C. *3 Semester hours of Academy Option.*

D. *6 Semester hours of Foreign Language.*

E. *24 Semester hours of major's courses to view the breadth, key concepts, and integration of biology:*

1. Biology 330 Zoology

2. Biology 331 Botany
3. Biology 332 Microbial Diversity
4. Biology 360 Cell and Molecular Biology
5. Biology 363 Genetics
6. Biology 380 Principles of Ecology
7. Biology 480 First-Class Biology Seminar
8. Human Physiology Option*

* The Human Physiology Option emphasizes an integrated view of living functions, primarily at the systems level and focused on human biology. Accepted courses are Biology 410, Anatomy and Physiology: Sensory and Motor Integration; Biology 440, Anatomy and Physiology: Visceral Systems Integration; and Biology 345, Aerospace Physiology.

F. *18 Additional semester hours of majors courses. Certain optional courses are suggested for cadets wishing to emphasize or concentrate on different areas of biology. Depending upon the individual cadet's natural talents, interests, and abilities, specific courses will be suggested by their academic advisor.*

1. Biology Option #1 *
2. Biology Option #2 *
3. Biology Option #3 *
4. Chemistry Option: Chem 230 or Chem 233
5. Scientific Breadth Option **
6. Scientific Breadth Option **

* Biology Options can be filled by any course, 300-level or above, offered by the Biology Department. A maximum of one Organic Chemistry <u>or</u> Biochemistry course may fill a Biology option (only Chem 233, 234, 244, 434).

** The Scientific Breadth Options are designed to enhance understanding of biological science, broaden scientific vision, or link biological science to related Air Force career areas. These options can include any 200-level or above course in the Departments of Biology, Chemistry, Physics, Computer Science, and Mathematical Sciences, the select courses listed below, or other courses with Department Head permission.

Beh Sci 320	Lifespan Development
Beh Sci 355	Biopsychology
Beh Sci 373	Introduction to Human Factors
Civ Engr 362	Introduction to Environmental Engineering
Civ Engr 368	Hazardous Waste Management and Contaminant Transport
Civ Engr 369	Introduction to Air Pollution
Civ Engr 463	Wastewater Treatment Plant Design
Civ Engr 467	Water Treatment Principles and Design
Geog 350	Human Geography
Geog 351	Introduction to Physical Geography
Geog 353	Geomorphology

Geog 360	Environmental Geography
Geog 382	Remote Sensing and Imagery Analysis
History 482	History of Science and Technology
Law 371	Environmental Law and Policy
Philos 330	Introduction to the Philosophy of Science
Philos 410	Medical Ethics

AREAS OF INTEREST The Biology major can meet a wide variety of cadet interests, some of which are listed below. However, the major is designed to be flexible to each cadet's interest, allowing each cadet to *tailor a program* unique to their own biological interests.

A. Environmental and Organismal Biology: Combines general knowledge of Biology, the physical world (chemistry, meteorology, geology, geography, physics), the human element (politics, economics, and behavior), and problem-solving skills (engineering and mathematics) to understand man's role and impact on the planet Earth. Suggested courses: Vertebrate Zoology, Microbiology, Applied Ecology, Environmental Chemistry, Biochemistry, Fundamental Hydraulics, Introduction to Environmental Engineering, and numerous Geography courses.

Bioenvironmental Engineering
Application of engineering and scientific knowledge and techniques to identify and manage risks for health protection, to develop procedures, techniques, and equipment, to conduct and supervise engineering services, and to participate in medical-facility programs. Suggested courses: Microbiology, Introduction to Environmental Engineering, Hazardous Waste Management and Containment Transport, Introduction to Air Pollution, Wastewater Treatment Plant Design, Water Treatment Principles and Design, Organic Chemistry Laboratory, Biochemistry, and Molecular Biology Methods.

B. Cellular and Molecular Biology: Combines the study of biochemical and cellular-level processes to understand the rapidly growing fields of genetic engineering, immunology, disease defense, hormonal control, aging, and cancer. Suggested courses: Microbiology, Molecular Biology Methods, Organic Chemistry, and Biochemistry.

C. Human Biology: Comprises the study of human anatomy and physiology. There are various avenues of study within this sub-discipline:

Human Factors and Performance
Plan of elective courses can be tailored to student interests in the physical, physiological, mechanical, and psychological factors related to the man-machine interface (human factors) or to optimizing and teaching neuromuscular skills (performance, athletics). Suggested courses: Strategies for Health, Biomechanics, Aerospace Physiology, Space Biology and Exploration, Anatomy and Physiology: Sensory and Motor Integration, Aviation Psychology, Introduction to Human Factors, Biopsychology, and Engineering Psychology.

Aerospace Physiology

Management of aerospace-physiological training and hyperbaric-therapy units, performance of research, and provision of expertise on the human aspects of manned high-altitude/high-speed flight (including space flight). Suggested courses: Aerospace Physiology, Space Biology and Exploration, Anatomy and Physiology: Sensory and Motor Integration, Anatomy and Physiology: Visceral Systems Integration, Strategies for Health, Human Nutrition, Exercise Physiology.

Physical Therapy
Direct form of professional patient care that can be applied to patients referred from most disciplines of medicine. Required courses: Anatomy and Physiology: Sensory and Motor Integration, Anatomy and Physiology: Visceral Systems Integration, and Lifespan Development. Suggested courses: Biomechanics and Exercise Physiology.

D. Professional or Advanced Degree: This track is designed for cadets pursuing graduate school or a professional health degree. Specific courses should be coordinated with your academic advisor.

SCHEDULING CONSIDERATIONS: The Biology major is designed to be flexible, allowing cadets to design a program that most meets their interest in biology. There are several course options that offer flexibility to cadets building their schedule.

SUGGESTED COURSE SEQUENCE

Biology Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Chem 141	3	2	Chem 230 or 233	3	1	Biology 363	3	1	Biology Option 2	3	1
	History 101	3	1	**Law 220**	3	1	Biology 380	3	1	Biology 331	3	2
Fall	**English 111**	3	1	**Soc Sci 112**	3	1	Biology Option 1	3	1	Biology 480	3	1
	Math 141	3	1	**Biology 215**	3	2	**Math 300**	3	1	**Beh Sci 310**	3	1
	Engr 100	3	1	**Physics 215**	3	2	**Law 220**	3	1	**Astro Engr 310**	3	1
				Foreign Lang I	3	2	**Civ Engr 210**	3	1	**Philos 310**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
		15.5	8		19	11		19	8		18.5	9
	Chem 142	3	2	Biology 330	3	2	Biology 332	3	1	Biology Option 3	3	2
	Physics 110	3	2	**History 202**	3	1	Biology 360	3	2	Sci Breadth Option 2	3	1
Spring	**Math 142**	3	1	**Engr Mech 120**	3	1	Sci Breadth Option 1	3	1	Human Physio Option	3	2
	Comp Sci 110	3	1	**English 211**	3	1	**Pol Sci 311**	3	1	***Academy Option***	3	1
	Beh Sci 110	3	1	**El Engr 215**	3	1	**Mgt 200**	2	1	**English 411**	3	1
	MSS 100	3	1	**Foreign Lang II**	3	2	**Econ 200**	2	1	**MSS 400**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	**Geog 310**	3	1	*Phy Ed*	0.5	2
							Phy Ed	0.5	2			
		18.5	10		18.5	10		19.5	10		18.5	10

Course Unit Summary
Core (31)
Major (14)
Foreign Language (2)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	42.0	"
Foreign Languages=	6.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total=	**147.0**	

CHEMISTRY

THE CHEMISTRY MAJOR AT A GLANCE: The major in Chemistry is recommended for those who are interested in chemical or biochemical research or applications. It provides fundamental knowledge in analytical, inorganic, organic, and physical chemistry and allows the cadet to select one or two of these areas for advanced study. The major is designed to prepare cadets for a junior officer position in research, development, or graduate training. It emphasizes the use of the laboratory methods for reinforcement of lecture material and individual research projects. To discuss the Chemistry major, contact the DFC AIC at 3-2960.

Cadets must declare the accredited Chemistry major prior to the fall semester of their third-class year. Declaration in the spring semester of the fourth-class year is highly recommended.

COURSE REQUIREMENTS: 147 Semester hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		Substitutes for
Chem 335	Physical Chemistry I - Thermodynamics and Equilibria	Systems Option

B. *5 Semester hours of Director of Athletics' courses.*

C. *3 Semester hours of Academy Option.*

D. *No Foreign Language courses required.*

E. *48 Semester hours of major's courses:*

The major's options are Chemistry, Biochemistry, and Materials Science.

Chemistry Option

This major is approved by the Committee on Professional Training of the American Chemical Society. Cadets successfully completing this academic program are awarded the degree of Bachelor of Science in Chemistry.

1. Math 243 (or Math 253) Calculus III (or Advanced Placed Calculus III)
2. Chem 222 Analytical Chemistry
3. Chem 233 Organic Chemistry I
4. Chem 234 Organic Chemistry II
5. Chem 243 Organic Chemistry Laboratory
6. Chem 244 Instrumental Organic Chemistry
7. Chem 336 Physical Chemistry II - Quantum Theory and Its Applications
8. Chem 345 Physical Chemistry Laboratory

9. Chem 431 Theoretical Inorganic Chemistry
10. Chem 434 Introductory Biochemistry
    or Chem 481 Biochemistry I
11. Chem 445 Advanced Laboratory Techniques
12. Basic Science 300/400-Level Option 1
13. Basic Science 300/400-Level Option 2
14. Chem Concentration 1*
15. Chem Concentration 2*
16. Chem Concentration 3*

*One Chem Concentration may be any Chem 300/400-level course; one may be any Chem 400-level course; and one must be a three-hour Chem 400-level laboratory course. A maximum of six hours of Chem 499 may be counted toward the major.

Biochemistry Option

This academic program is approved by the Committee on Professional Training of the American Chemical Society. Cadets successfully completing this option are awarded the degree of Bachelor of Science in Chemistry.

1. Math 243 (or Math 253) Calculus III (or Advanced Placed Calculus III)
2. Chem 222 Analytical Chemistry
3. Chem 233 Organic Chemistry I
4. Chem 234 Organic Chemistry II
5. Chem 243 Organic Chemistry Laboratory
6. Chem 244 Instrumental Organic Chemistry
7. Chem 336 Physical Chemistry II - Quantum Theory and Its Applications
8. Chem 345 Physical Chemistry Laboratory
9. Chem 431 Theoretical Inorganic Chemistry
10. Chem 445 Advanced Laboratory Techniques
11. Chem 481 Biochemistry I
12. Chem 482 Biochemistry II
13. Chem 491 Biochemistry Laboratory
14. Biology Option*
15. Chem Concentration**
16. Chem/Bio Option***

*The Biology Option must be one of the following: Biology 360, Biology 363, Biology 410, Biology 431, Biology 440, or Biology 464. Biology 360 is strongly recommended.

**The Chem Concentration may be any Chem 400-level laboratory course.

***The Chem/Bio Option may be any 300/400-level Chemistry or Biology course.

Materials Science Option

The Materials Science option 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. This course of study 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. To investigate this relatively new field of study we have taken advantage of a wide range of expertise found at the Air Force Academy.

This academic program is accredited by the Committee on Professional Training of the American Chemical Society. Cadets who successfully complete this option are awarded the degree of Bachelor of Science in Chemistry.

1. Math 243 (or Math 253)	Calculus III (or Advanced Placed Calculus III)
2. Chem 222	Analytical Chemistry
3. Chem 233	Organic Chemistry I
4. Chem 234	Organic Chemistry II
5. Chem 243	Organic Chemistry Laboratory
6. Chem 336	Physical Chemistry II - Quantum Theory and Its Applications
7. Chem 345	Physical Chemistry Laboratory
8. Chem 431	Theoretical Inorganic Chemistry
9. Chem 434	Introductory Biochemistry
or Chem 481	Biochemistry I
10. Chem 440	Polymer Chemistry
11. Chem 445	Advanced Laboratory Techniques
12. Chem 465	Chemistry of Advanced Materials
13. Engr Mech 340	Materials Science for Engineers
14. Engr Mech 440	Physical Metallurgy
15 Chem Concentration 1*	
16. Chem Concentration 2*	

*One Chem Concentration may be any Basic Sciences or Engineering 300/400-level lecture or laboratory course; one must be a Chem 400-level laboratory course or Physics 393. A maximum of six hours of Chem 499 may be counted toward the major.

SUGGESTED COURSE SEQUENCE

Chemistry Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Chem 141	3	2	Chem 233	3	1	Chem 222	3	2	Chem 431	3	1
	Math 141	3	1	Chem 243	3	2	**Chem 335**	3	1	Basic Sci 300/400 Opt 1	3	2
Fall	**Engr 100**	3	1	**Soc Sci 112**	3	1	**Mgt 200**	2	1	Basic Sci 300/400 Opt 2	3	1
	English 111	3	1	**Beh Sci 110**	3	1	**Econ 200**	2	1	Chem Concentration 1	3	2
	Comp Sci 110	3	1	**Civ Engr 210**	3	1	**Math 300**	3	1	***Academy Option***	3	2
	Phy Ed	0.5	2	**Physics 215**	3	2	**El Engr 215**	3	1	**English 411**	3	1
				Phy Ed	1	2	**Pol Sci 311**	3	1	*Phy Ed*	0.5	2
							Phy Ed	1	2			
		15.5	8		19	10		20	10		18.5	11
	Chem 142	3	2	Chem 234	3	1	Chem 336	3	1	Chem 434	3	1
	Math 142	3	1	Chem 244	3	2	Chem 345	3	2	Chem 445	3	2
Spring	**History 101**	3	1	Math 243	3	1	**Beh Sci 310**	3	1	Chem Concentration 2	3	1
	MSS 100	3	1	**Biology 215**	3	2	**Aero Engr315**	3	1	Chem Concentration 3	3	2
	Engr Mech 120	3	1	**English 211**	3	1	**Law 220**	3	1	**Astro Engr 310**	3	1
	Physics 110	3	2	**History 202**	3	1	**Philos 310**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		18.5	10		18.5	10		18.5	9		18.5	10

Course Unit Summary
Core (31)
Major (16)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

Biochemistry Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Chem 141	3	2	Chem 233	3	1	Biology Option	3	1	Chem 431	3	1
	Math 141	3	1	Chem 243	3	2	Chem 222	3	2	Chem 481	3	1
Fall	**Engr 100**	3	1	**Soc Sci 112**	3	1	**Chem 335**	3	1	Chem 491	3	2
	English 111	3	1	**Beh Sci 110**	3	1	**Pol Sci 311**	3	1	***Academy Option***	3	1
	Comp Sci 110	3	1	**Civ Engr 210**	3	1	**Mgt 200**	2	1	**Aero Engr 315**	3	1
	Phy Ed	0.5	2	**Physics 215**	3	2	**Econ 200**	2	1	**English 411**	3	1
				Phy Ed	1	2	**Math 300**	3	1	*Phy Ed*	0.5	2
							Phy Ed	1	2			
		15.5	8		19	10		20	10		18.5	9
	Chem 142	3	2	Chem 234	3	1	Chem 336	3	1	Chem 482	3	1
	Math 142	3	1	Chemi 244	3	2	Chem 345	3	2	Chem 445	3	2
Spring	**History 101**	3	1	Math 243	3	1	Chem/Bio Option	3	1	Chem Concentration	3	1
	MSS 100	3	1	**Biology 215**	3	2	**Beh Sci 310**	3	1	**Philos 310**	3	1
	Engr Mech 120	3	1	**English 211**	3	1	**El Engr 215**	3	1	**Astro Engr 310**	3	1
	Physics 110	3	2	**History 202**	3	1	**Law 220**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		18.5	10		18.5	10		18.5	9		18.5	9

Course Unit Summary
Core (31)
Major (16)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

Material Science Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Chem 141	3	2	Chem 233	3	1	**Aero Engr 315**	3	1	Chem 431	3	1
	Math 141	3	1	Chem 243	3	2	**Pol Sci 311**	3	1	Engr Mech 440	3	2
Fall	**Engr 100**	3	1	Math 243	3	1	**Chem 335**	3	1	Chem Concentration 1	3	2
	English 111	3	1	**Beh Sci 110**	3	1	**Math 300**	3	1	***Academy Option***	3	1
	Comp Sci 110	3	1	**Soc Sci 112**	3	1	**Mgt 200**	2	1	**Astro Engr 310**	3	1
	Phy Ed	0.5	2	**Physics 215**	3	2	**Econ 200**	2	1	**English 411**	3	1
				Phy Ed	1	2	**El Engr 215**	3	1	*Phy Ed*	0.5	2
							Phy Ed	1	2			
		15.5	8		19	10		20	9		18.5	10
	Chem 142	3	2	Chem 222	3	2	Chem 336	3	1	Chem 434	3	1
	Math 142	3	1	Chem 234	3	1	Chem 345	3	2	Chem 445	3	2
Spring	**History 101**	3	1	**Civ Engr 210**	3	1	Engr Mech 340	3	1	Chem 465 (Chem 440)	3	2
	MSS 100	3	1	**Biology 215**	3	2	Chem 440 (Chem 465)	3	2	Chem Concentration 2	3	1
	Engr Mech 120	3	1	**English 211**	3	1	**Beh Sci 310**	3	1	**Philos 310**	3	1
	Physics 110	3	2	**History 202**	3	1	**Law 220**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		18.5	10		18.5	10		18.5	10		18.5	10

Course Unit Summary
Core (31)
Major (16)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

CIVIL ENGINEERING

THE CIVIL ENGINEERING MAJOR AT A GLANCE: Civil engineering is one of the broadest of the engineering disciplines, encompassing many interdependent technical specialties. As a civil engineer, you 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.

You will 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 you develop your skills, you 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.

What is Civil Engineering like in the Air Force? 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. Your 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, your expertise is required to plan, manage, and direct the civil engineering efforts on a command-wide basis.

If you like science and mathematics and are curious about how things work, then perhaps civil engineering is the major for you. The program is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology. 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 goals of the Civil Engineering Program are to prepare cadets to become Air Force officers who:

- Possess breadth of integrated, fundamental knowledge in the basic sciences, engineering, 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 USAF core values, and
- Can function effectively in contingency operations.

The Program Operational Goals above describe what the Air Force would like to see in our graduates two to three years into their careers as Air Force Engineering Officers. To best support these goals, our program's curriculum is designed such that, by graduation, our graduates possess certain qualities or outcomes. These *Program Curricular Outcomes*, listed below, call for our graduating cadets to satisfactorily demonstrate:

- Application of the fundamental concepts of civil 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 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 an independent learner while knowing when to seek help,
- Knowledge of the role of Air Force engineering officers in our global society, and
- Knowledge of contemporary social, economic, political, military, and engineering issues.

COURSE REQUIREMENTS: 147 Semester hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
Engr 311	Electrical Power Systems	Systems Option
Math 356	Probability and Statistics for Engineers and Scientists	Math 300
El Engr 231	Electrical Circuits and Systems I	El Engr 215

B. *5 Semester hours of Director of Athletics courses.*

C. *3 Semester hours of Academy Option.*

D. *No Foreign Language courses required.*

E. *48 Semester hours of major's courses:*

1. Math 243 (or Math 253) Calculus III (or Advanced Placed Calculus III)
2. Math 245 Differential Equations

3.	Civ Engr 330	Elementary Structural Analysis
4.	Civ Engr 351	Civil Engineering Practices - Field Engineering
5.	Civ Engr 361	Fundamental Hydraulics
6.	Civ Engr 362	Introduction to Environmental Engineering
7.	Civ Engr 372	Behavior and Analysis of Structures
8.	Civ Engr 373	Behavior and Design of Steel Members
9.	Civ Engr 390	Introduction to Soil Mechanics
	Civ Engr 405	First-Class Seminar
10.	Civ Engr 474	Behavior and Design of Concrete Members
11.	Civ Engr 480	Project Management and Contract Administration
12.	Civ Engr 488	Pavement Design and Transportation
13.	Design Option I	(See Supplemental Information #1)
14.	Design Option II	(See Supplemental Information #1)
15.	Engr/Bas Sci Opt	(See Supplemental Information #2)
16.	Basic Sci Opt	(See Supplemental Information #3)

Supplemental Information:

1. Design Option I and Design Option II must be chosen from the following courses:

Civ Engr 463	Wastewater Treatment Plant Design
Civ Engr 464	Architectural Design
Civ Engr 467	Water Treatment Principles and Design
Civ Engr 468	Solid & Hazardous Waste Facilities Design
Civ Engr 469	Design of Air Pollution Controls
Civ Engr 473	Structural Design
Civ Engr 485	Construction Project Management
Civ Engr 491	Foundation Engineering
Civ Engr 492	Earth Structures: Embankments/Slopes/Buried Structures

2. An Engineering/Basic Science Option is any course of at least three semester hours taught by either the Engineering Sciences Division or the Basic Sciences Division that has not been used to satisfy any other curriculum requirement. Remedial courses may not be used to satisfy this option.

3. For a Basic Science Option, any course taught by the departments listed below may satisfy this option.

Department of Biology
Department of Chemistry
Department of Mathematical Sciences
Department of Physics

Additionally, Geog 310, Geog 360, or Geog 382 may be used to satisfy this option.

Note: Although the Department of Computer Science is part of the Basic Sciences Division,

Computer Science courses cannot be taken to fulfill this option due to ABET requirements.

Civil Engineering courses which satisfy this option include those in paragraph 1 above that were not used for Design Option I and II as well as the following:

Civ Engr 215	Computer Applications for Civil Engineers
Civ Engr 368	Hazardous Waste Management and Contaminant Transport
Civ Engr 369	Introduction to Air Pollution

SUGGESTED COURSE SEQUENCE

Civil Engineer Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
Fall	**Chem 141**	3	2	Math 243	3	1	Civ Engr 361	3	1	Civ Engr 474	3	1
	History 101	3	1	**Physics 215**	3	2	Civ Engr 362	3	1	CE Design Opt #1	3	1
	English 111	3	1	**Engr Mech 120**	3	1	Civ Engr 372	3	1	**Beh Sci 310**	3	1
	Math 141	3	1	**English 211**	3	1	Civ Engr 390	3	1	**Astro Engr 310**	3	1
	Engr 100	3	1	**Biology 215**	3	2	**Pol Sci 311**	3	1	**Engr 311**	3	1
				Soc Sci 112	3	1	**Aero Engr 315**	3	1	**English 411**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
		15.5	8		19	10		19	8		18.5	8
Spring	**Physics 110**	3	2	Civ Engr 330	3	1	Civ Engr 373	3	1	Civ Engr 480	3	1
	Chem 142	3	2	Math 245	3	1	Bas Sci Opt	3	1	Civ Engr 488	3	1
	Math 142	3	1	Engr/Bas Sci Opt	3	1	**Math 356**	3	1	CE Design Opt #2	3	1
	Comp Sci 110	3	1	**History 202**	3	1	**Law 220**	3	1	Civ Engr 405	0	1
	Beh Sci 110	3	1	**Mgt 200**	2	1	**El Engr 231**	3	1	Civ Engr 351 (summer)	3	0
	MSS 100	3	1	**Econ 200**	2	1	**Philos 310**	3	1	***Academy Option***	3	1
	Phy Ed	0.5	2	**Civ Engr 210**	3	1	*Phy Ed*	0.5	2	**MSS 400**	3	1
				Phy Ed	0.5	2				*Phy Ed*	0.5	2
		18.5	10		19.5	9		18.5	8		18.5	8

Course Unit Summary
Core (31)
Major (16)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Acad. Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

COMPUTER ENGINEERING

THE COMPUTER ENGINEERING MAJOR AT A GLANCE: 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 USAFA acquire these skills through an interdisciplinary approach that intermingles courses from Computer Science with offerings from Electrical Engineering. This course mix provides the broad, varied background an engineer needs to succeed in this dynamic field.

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, 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, and
- Know and practice their ethical and professional responsibilities as embodied in the United States Air Force core values.

The *Program Operational Goals* listed above describe the skills and knowledge required of computer engineering graduates during their careers as Air Force engineering officers. To support these goals, our program's curriculum is designed such that, by graduation, our graduates possess certain qualities or outcomes. The *Program Curricular Outcomes* are listed below. Each Computer Engineering 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 communications 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 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 help,

- Knowledge of the role of Air Force engineering officers in our global society, and
- Knowledge of contemporary social, political, military, and engineering issues.

Cadets who successfully complete the Computer Engineering major are awarded a Bachelor of Science in Computer Engineering degree that is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology. The Computer Engineering major 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 both in the Air Force and in society as a whole.

If you are considering Computer Engineering as your major, you need to take El Engr 231 and Comp Sci 210 in the fall semester of your 3° year.

COURSE REQUIREMENTS: 147 semester hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
Engr 311	Electrical Power Systems	Systems Option
Math 356	Probability and Statistics for Engineers and Scientists	Math 300
El Engr 231	Electrical Circuits and Systems I	El Engr 215

B. *5 Semester hours of Director of Athletics courses.*

C. *3 Semester hours of Academy Option.*

D. *No Foreign Language courses required.*

E. *48 Semester hours of major's courses:*

1. Comp Engr 463 — Capstone Design Project I
2. Comp Engr 464 — Capstone Design Project II
3. Comp Engr 373 — Digital VLSI Circuits
4. Comp Sci 210 — Introduction to Programming
5. Comp Sci 220 — Data Abstraction
6. Comp Sci 359 — Programming Languages
7. Comp Sci 467 — Computer Networks
8. Comp Sci 483 — Operating Systems
9. El Engr 281 — Introductory Digital Systems
10. El Engr 332 — Circuits and Systems II
11. El Engr 321 — Electronics I
12. El Engr 382 — Microcomputer Programming
13. El Engr 383 — Microcomputer System Design I
14. El Engr 485 — Computer Architecture
15. Math 245 — Differential Equations
16. Math 340 — Discrete Mathematics

SUGGESTED COURSE SEQUENCE

Computer Engineering Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Chem 141	3	2	Math 245	3	1	El Engr 321	3	2	Comp Engr 463	3	2
	Comp Sci 110	3	1	Comp Sci 210	3	1	El Engr 332	3	1	Comp Sci 359	3	1
Fall	**English 111**	3	1	**El Engr 231**	3	1	El Engr 382	3	1	**Beh Sci 310**	3	1
	Math 141	3	1	**English 211**	3	1	Comp Sci 483	3	1	**Math 356**	3	1
	Engr 100	3	1	**Physics 215**	3	2	**Mgt 200**	2	1	**English 411**	3	1
				Soc Sci 112	3	1	**Econ 200**	2	1	**Philos 310**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	**Biology 215**	3	2	*Phy Ed*	0.5	2
							Phy Ed	1	2			
		15.5	8		19	9		20	11		18.5	9
	Physics 110	3	2	El Engr 281	3	1	Comp Engr 373	3	2	Comp Engr 464	3	2
Spring	**Chem 142**	3	2	Math 340	3	1	El Engr 383	3	2	El Engr 485	3	1
	Math 142	3	1	Comp Sci 220	3	1	Comp Sci 467	3	1	***Academy Option***	3	1
	MSS 100	3	1	**Beh Sci 110**	3	1	**Pol Sci 311**	3	1	**Aero Engr 315**	3	1
	Engr Mech 120	3	1	**Engr 311**	3	1	**Law 220**	3	1	**Astro Engr 310**	3	1
	History 101	3	1	**History 202**	3	1	**Civ Engr 210**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		18.5	10		18.5	8		18.5	10		18.5	9

Course Unit Summary
Core (31)
Major (16)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

COMPUTER SCIENCE

THE COMPUTER SCIENCE MAJOR AT A GLANCE: Successful completion of the Computer Science major leads to the degree of Bachelor of Science in Computer Science and prepares cadets to be leaders in an information-based and network-centric Air Force. The Computer Science program is accredited by the Computing Accreditation Commission of the Accreditation Board for Engineering and Technology.

The goals of the Computer Science program are to produce leaders of character who:

- Apply a broad and deep understanding of the field of computer science,
- Can specify, design, implement, test, debug and maintain computer-based systems,
- Are fluent in at least one general-purpose programming language,
- Independently learn new programming languages and applications,
- Write and speak effectively on technical subjects,
- Are committed to the highest ethical standards in the use of computers,
- Work well with others, and
- Excel in graduate study.

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 beyond Comp Sci 110, Introduction to Computing, 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 Information Assurance option enter the Air Force as highly skilled information warriors.

Cadets interested in the Computer Science major should take Comp Sci 110 or Comp Sci 110H in their first or second semester. Computer Science majors must take Comp Sci 210, Introduction to Programming, and El Engr 281, Introductory Digital Systems, in their third semester. If you have any questions about the Computer Science major or career opportunities, please stop by the Computer Science department or call the Computer Science Advisor-in-Charge at 3-3590.

COURSE REQUIREMENTS: 147 Semester hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		Substitutes for
Math 356	Probability and Statistics for Engineers and Scientists	Math 300
Ops Rsch 310	Systems Analysis	Systems Option

B. *5 Semester hours of Director of Athletics courses.*

C. *3 Semester hours of Academy Option courses.*

D. *No Foreign Language courses required.*

E. *48 Semester hours of major's courses:*

1. Math 340	Discrete Mathematics
2. El Engr 281	Introductory Digital Systems
3. Comp Sci 210	Introduction to Programming
4. Comp Sci 220	Data Abstraction
5. Comp Sci 351	Computer Organization and Architecture
6. Comp Sci 359	Programming Paradigms
7. Comp Sci 364	Information Storage and Retrieval
8. Comp Sci 380	Design and Analysis of Algorithms
9. Comp Sci 426	Languages and Machines
10. Comp Sci 453	Software Engineering I
11. Comp Sci 454	Software Engineering II
12. Comp Sci 467	Computer Networks
13. Comp Sci 483	Operating Systems
14. Comp Sci Option	(See Supplemental Information 1)
15. Comp Sci Option	(See Supplemental Information 1)
16. Math Option	(See Supplemental Information 2)

Supplemental Information:

1. The following are Comp Sci Options:

Comp Sci 362	Computer Simulation
Comp Sci 431	Cryptography
Comp Sci 438	Computer Security and Information Warfare
Comp Sci 468	Network Security
Comp Sci 471	Artificial Intelligence
Comp Sci 474	Computer Graphics
Comp Sci 495	Special Topics in Computer Science
Comp Sci 496	Computer Science Seminar
Comp Sci 499	Independent Study
Astro Engr 436	Small Spacecraft Engineering I
Astro Engr 437	Small Spacecraft Engineering II
Beh Sci 472	Human-Computer Interaction

Note 1: Only one Astro course can count towards the Comp Sci option.
Note 2: Cadets must take at least one of the following: Comp Sci 431, Comp Sci 438, or Comp Sci 468.

2. The following are Math options:

Comp Sci 431	Cryptography
Math 243 (or Math 253)	Calculus III (or Advanced Placed Calculus III)

Math 245	Differential Equations
Math 359	Design and Analysis of Experiments
Philos 370	Introduction to Symbolic Logic

3 Required courses for the Computer Science-Information Assurance Option: Cadets that fill their Computer Science and/or Math options with the following courses will fulfill the requirements for the Information Assurance Option.

Information Assurance Option

Comp Sci 431	Cryptography
Comp Sci 438	Computer Security and Information Warfare
Comp Sci 468	Network Security

SUGGESTED COURSE SEQUENCE

Computer Science Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Beh Sci 110	3	1	Comp Sci 210	3	2	Comp Sci 359	3	1	Comp Sci 380	3	1
	Chem 141	3	2	El Engr 281	3	1	Comp Sci 483	3	1	Comp Sci 426	3	1
Fall	**Comp Sci 110**	3	1	**English 211**	3	1	Math Option	3	1	Comp Sci 453	3	2
	English 111	3	1	**Engr Mech 120**	3	1	**Civ Engr 210**	3	1	**Beh Sci 310**	3	1
	Math 141	3	1	**History 202**	3	1	**Mgt 200**	2	1	**Ops Rsch 310**	3	1
				Physics 215	3	2	**Econ 200**	2	1	**MSS 400**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	**Math 356**	3	1	*Phy Ed*	0.5	2
							Phy Ed	1	2		18.5	9
		15.5	8		19	10		20	9			
	Chem 142	3	2	Comp Sci 220	3	1	Comp Sci 364	3	1	Comp Sci 454	3	1
	Engr 100	3	1	Comp Sci 351	3	1	Comp Sci 467	3	1	Comp Sci Option	3	1
Spring	**History 101**	3	1	Math 340	3	1	**Astro Engr 310**	3	1	Comp Sci Option	3	1
	Math 142	3	1	**Biology 215**	3	2	**Law 220**	3	1	***Academy Option***	3	1
	MSS 100	3	1	**El Engr 215**	3	1	**Philos 310**	3	1	**Aero Engr 315**	3	1
	Physics 110	3	2	**Soc Sci 112**	3	1	**Pol Sci 311**	3	1	**English 411**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		18.5	10		18.5	9		18.5	8		18.5	8

Course Unit Summary
Core (31)
Major (16)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy Options =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

ECONOMICS

THE ECONOMICS MAJOR AT A GLANCE: 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 cadets to focus on the international arena, public policy and finance, or quantitative economics. The major is designed to help a student develop analytical skills which can be applied in a variety of circumstances. Cadets 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.

COURSE REQUIREMENTS: 147 Semester Hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		Substitutes for
Math 377	Applied Probability and Statistics	Math 300
Ops Rsch 310	Systems Analysis	Systems Option

B. *5 Semester hours of Director of Athletics courses.*

C. 3 *Semester hours of Academy Option.*

D. *6 Semester hours of Foreign Language.*

E. *42 Semester hours of major's courses:*

1. Econ 332 — Microeconomic Theory I
2. Econ 333 — Microeconomic Theory II
3. Econ 355 — Principles of Macroeconomics
4. Econ 356 — Intermediate Macroeconomics
5. Econ 340 — Development of Economic Thought
6. Econ 365 — Analysis of Empirical Economic Data
7. Econ 465 — Introduction to Econometrics
8. Econ 450 — International Economics
9. Econ 478 — Defense Economics
10. Mgt 341 — Financial Accounting

11.-14. Econ Electives — (See Supplemental Information)

Supplemental Information:

Two of the four Econ Electives must be 300- or 400-level economics courses (or Soc Sci 420), excluding Econ 301 and Econ 374. The two remaining Econ Electives can be any 300- or 400-

level economics course or be from the list below:

For Lang ≥ 200-level	
Mgt 342	Managerial Accounting
Mgt 372	Introduction to Investing & Financial Responsibility
Mgt 375	Marketing
Mgt 391	Management Information Systems
Mgt 392	Electronic Commerce
Mgt 437	Managerial Finance
Mgt 477	Production and Operations Management
Math 243 (or Math 253)	Calculus III (or Advanced Placed Calculus III)
Math 245	Differential Equations
Math 320	Foundations of Mathematics
Math 340	Discrete Mathematics
Math 342	Numerical Analysis
Math 359	Design and Analysis of Experiments
Math 360	Linear Algebra
or Math 344	Matrices and Differential Equations
Math 366	Real Analysis I
Math 377	Applied Probability and Statistics
Ops Rsch 321	Probabilistic Models
Ops Rsch 411	Topics in Mathematical Programming
Ops Rsch 419	Capstone in Operations Research: Case Studies
Ops Rsch 420	Capstone in Operations Research
Philos 330	Introduction to the Philosophy of Science
Law 340	Business Law
Law 462	Government Contract Law
Pol Sci 394	Comparative Government and Politics
Pol Sci 444	International Political Economy
Pol Sci 445	International Organization & Global Issues
Pol Sci 460	Comparative Security Policy and Civil-Military Relations
Soc Sci 483	Principles of Negotiation & the Mediation Process
Sys Engr 290	Systems Engineering I
Sys Engr 301	Systems Engineering II

Note: Students seriously considering graduate school should take as many of the quantitative economic courses as possible. The quantitative options introduce the Economics major to some of the relatively difficult subjects before beginning your graduate studies. Students seriously considering Financial Management and/or Cost Analysis are encouraged to take Mgt 342.

SUGGESTED COURSE SEQUENCE

Economics Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Chem 141	3	2	**Econ 200**	2	1	Econ 332	3	1	Econ 465	3	1
	Comp Sci 110	3	1	**Mgt 200**	2	1	Econ 355	3	1	Econ Elective 2	3	1
Fall	**English 111**	3	1	**Engr Mech 120**	3	1	**Beh Sci 310**	3	1	Econ 450	3	1
	Math 141	3	1	**Beh Sci 110**	3	1	**Aero Engr 315**	3	1	Mgt 341	3	1
	Foreign Lang I	3	2	**Physics 110**	3	2	**Math 356**	3	1	**English 411**	3	1
				Soc Sci 112	3	1	**Ops Rsch 310**	3	1	**Astro Engr 310**	3	1
	Phy Ed	0.5	2	**El Engr 215**	3	1	*Phy Ed*	1	2	*Phy Ed*	0.5	2
				Phy Ed	0.5	2						
		15.5	9		19.5	10		19	8		18.5	8
	History 101	3	1	**Biology 215**	3	2	Econ 333	3	1	Econ 478	3	1
	Chem 142	3	2	**English 211**	3	1	Econ 340	3	1	Econ Elective 3	3	1
Spring	**Engr 100**	3	1	**History 202**	3	1	Econ 356	3	1	Econ Elective 4	3	1
	Math 142	3	1	**Law 220**	3	1	Econ 365	3	1	***Academy Option***	3	1
	MSS 100	3	1	**Physics 215**	3	2	Econ elective 1	3	1	**Pol Sci 311**	3	1
	Foreign Lang II	3	2	**Civ Engr 210**	3	1	**Philos 310**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		18.5	10		19	10		18.5	8		18.5	8

Course Unit Summary
Core (31)
Major (14)
Foreign Lang (2)
Academy Options (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	42.0	"
Foreign Lang =	6.0	"
Academy Options =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

ELECTRICAL ENGINEERING

THE ELECTRICAL ENGINEERING MAJOR AT A GLANCE: 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.

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, 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, and
- Know and practice their ethical and professional responsibilities as embodied in the United States Air Force core values.

The *Program Operational Goals* listed above describe the skills and knowledge required of electrical engineering graduates during their careers as Air Force engineering officers. To support these goals, our program's curriculum is designed such that, by graduation, our graduates possess certain qualities or outcomes. The *Program Curricular Outcomes* are listed below. Each Electrical Engineering 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 communications 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 an independent learner while knowing when to seek help,
- Knowledge of the role of Air Force engineering officers in our global society, and
- Knowledge of contemporary social, political, military, and engineering issues.

Cadets who successfully complete the Electrical Engineering major are awarded a Bachelor of Science in Electrical Engineering degree that is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology. 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.

If you are considering Electrical Engineering as your major, you need to take El Engr 231 (in lieu of El Engr 215) and Engr 311.

COURSE REQUIREMENTS: 147 semester hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
Engr 311	Electrical Power Systems	Systems Option
Math 356	Probability and Statistics for Engineers and Scientists	Math 300
El Engr 231	Electrical Circuits and Systems I	El Engr 215

B. *5 Semester hours of Director of Athletics courses.*

C. *3 Semester hours of Academy Option.*

D. *No Foreign Language courses required.*

E. *48 Semester hours of major's courses:*

1. El Engr 281 — Introductory Digital Systems
2. El Engr 321 — Electronics I
3. El Engr 322 — Electronics II
4. El Engr 332 — Circuits and Systems II
5. El Engr 333 — Continuous-Time Signals and Linear Systems
6. El Engr 343 — Electromagnetics
7. El Engr 382 — Microcomputer Programming
8. El Engr 434 — Discrete-Time Signals and Systems
9. El Engr 447 — Communication Systems I
10. El Engr 463 — Capstone Design Project I
11. El Engr 464 — Capstone Design Project II
12. Math 243 (or Math 253) — Calculus III (or Advanced Placed Calculus III)
13. Math 245 — Differential Equations
14. Math 346 — Engineering Math
15. El Engr Option 1 — (See Supplemental Information 1)

16. El Engr Option 2 (See Supplemental Information 1)

Supplemental Information:

1. The elective options provide the opportunity for more in-depth study that will help prepare you for your career in the Air Force. They also help provide the foundation for your senior design project. El Engr 463 and El Engr 464 are the capstone courses of the Electrical Engineering major. The Department of Electrical Engineering offers four different 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. Figure 10-1 shows suggested course flows for the various areas of study.

Area 1: 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 for those who want to retain the flexibility to work and/or do graduate studies in electrical engineering, physics, medicine, or other technical fields.

Area 2: 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.

Area 3: 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.

Area 4: Controls - This area of study consists of up to four (4) 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.

Area 5: Universal Area - You are free to choose two classes from the approved "Elective Options" list to fulfill the Electrical Engineering major's elective requirements. These electives provide the opportunity to "pick and choose" classes that interest you.

The two Electrical Engineering Options must be chosen from the following list of courses.

El Engr 383	Microcomputer System Design I
El Engr 387	Introduction to Robotic Systems
El Engr 444	Applied Field Theory
El Engr 448	Communications Systems II
El Engr 472	Instrumentation System Fundamentals
El Engr 473	Introduction to CMOS VLSI Circuit Design
El Engr 484	Microcomputer System Design II
El Engr 485	Computer Architecture
El Engr 495	Special Topics (See Note 1)

El Engr 499	Independent Study (See Note 1)
Comp Engr 373	Digital VLSI Circuits
Engr 341	Linear Systems Analysis and Design
Engr 342	Linear Control System Analysis and Design
Astro Engr 443	Digital Control Theory and Design
Astro Engr 444	Modern Control Theory and Design

Note 1: El Engr 495 and El Engr 499 require Electrical Engineering Department Head approval.

2. Electrical Engineering majors are also highly encouraged to take Engr 402, Professional Engineering Development, and the Fundamentals of Engineering exam. Engr 402 provides an excellent review of the mathematics, engineering, and basic science curriculum. The flowchart on the following page shows the Electrical Engineering courses and areas of study.

SUGGESTED COURSE SEQUENCE

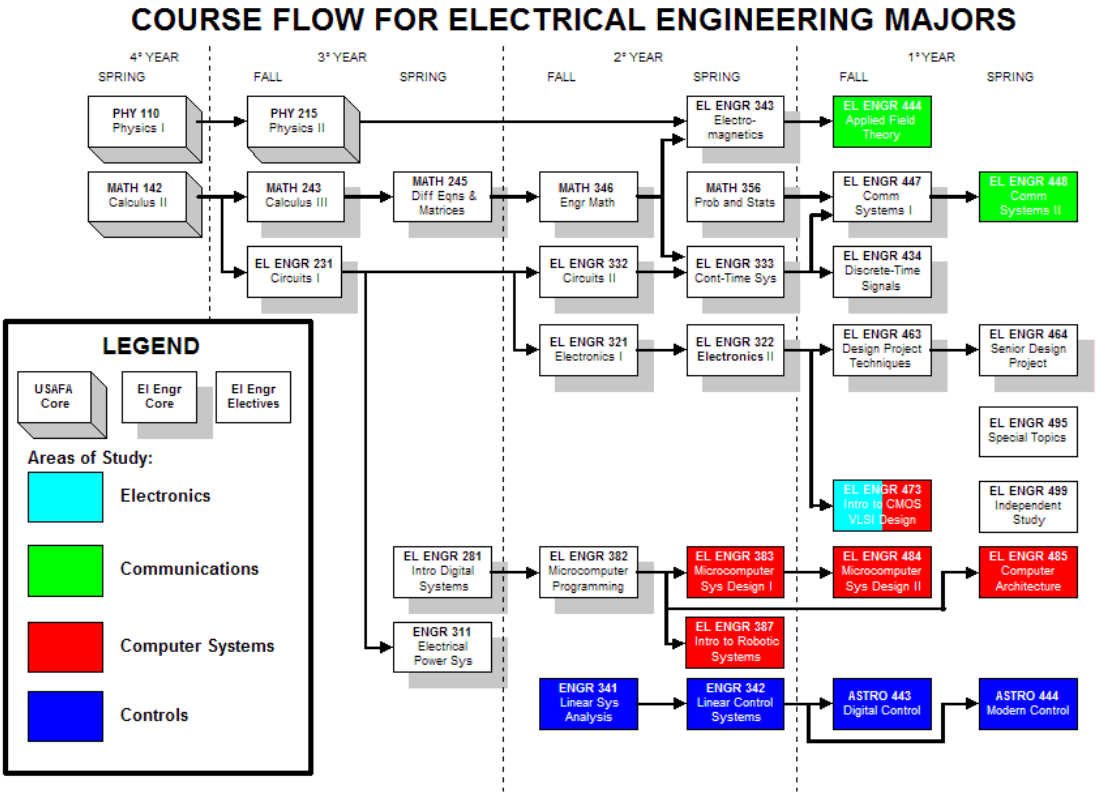
Electrical Engineering Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Chem 141	3	2	Math 243	3	1	El Engr 321	3	2	El Engr 434	3	1
	MSS 100	3	1	**El Engr 231**	3	1	El Engr 332	3	1	El Engr 447	3	1
Fall	**English 111**	3	1	**Beh Sci 110**	3	1	El Engr 382	3	1	El Engr 463	3	1
	Math 141	3	1	**English 211**	3	1	Math 346	3	1	El Engr Option	3	1
	Engr 100	3	1	**Physics 215**	3	2	**Mgt 200**	2	1	**Beh Sci 310**	3	1
				Soc Sci 112	3	1	**Econ 200**	2	1	**Philos 310**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	**Aero Engr 315**	3	1	*Phy Ed*	0.5	2
							Phy Ed	1	2			
		15.5	8		19	9		20	10		18.5	8
	Physics 110	3	2	El Engr 281	3	1	El Engr 322	3	2	El Engr 464	3	2
	Chem 142	3	2	Math 245	3	1	El Engr 333	3	1	El Engr Option	3	1
Spring	**Math 142**	3	1	**Civ Engr 210**	3	1	El Engr 343	3	1	***Academy Option***	3	1
	Comp Sci 110	3	1	**Biology 215**	3	2	**Math 356**	3	1	**English 411**	3	1
	Engr Mech 120	3	1	**Engr 311**	3	1	**Law 220**	3	1	**Astro Engr 310**	3	1
	History 101	3	1	**History 202**	3	1	**Pol Sci 311**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		18.5	10		18.5	9		18.5	9		18.5	9

Course Unit Summary
Core (31)
Major (16)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

Figure 10-1



ENGINEERING MECHANICS

THE ENGINEERING MECHANICS MAJOR AT A GLANCE: Engineering Mechanics is considered the foundation engineering discipline with roots tracing back to Archimedes, Leonardo daVinci, Galileo, and Sir Isaac Newton. Engineering Mechanics deals with forces acting on bodies (such as satellites, missiles, and aircraft) and how bodies dynamically respond to those forces. Nearly all more specialized engineering disciplines begin with one or more courses in engineering mechanics. The USAFA Engineering Mechanics degree is accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET).

If you want to design and build things, then you should consider majoring in Engineering Mechanics. If understanding, building, and using state-of-the-art materials such as composites and ceramics intrigue you, this challenging major may be right for you. If you aren't sure what engineering discipline to pursue right now and you want to keep your options open, this broad-based foundational major may be perfect for you.

The goal of the Department of Engineering Mechanics is to *Educate Engineers for the Military Profession*. The Engineering Mechanics program is specifically designed with the goal of generating:

- Officers who possess breadth of integrated, fundamental knowledge in engineering, the basic sciences, social sciences, and humanities; and depth of knowledge in engineering mechanics,
- Officers who communicate effectively,
- Officers who work effectively on teams and grow into team leaders,
- Officers who are independent learners, and (as applicable) successful in graduate school,
- Officers who can apply their knowledge and skills to solve Air Force engineering problems, both well- and ill-defined, and
- Officers who know and practice their ethical, professional, and community responsibilities as embodied in the USAF core values.

The *Program Operational Goals* above describe what the Air Force would like to see in our graduates as they begin their careers as Air Force Engineering Officers. To best support these goals, our program's curriculum is designed such that, by graduation, our graduates possess certain qualities or outcomes. These *Program Curricular Outcomes*, listed below, call for our graduating cadets to satisfactorily demonstrate:

- Application of the fundamental analysis concepts of engineering mechanics to solve engineering problems,
- Modeling, design, and fabrication techniques of systems with solid and fluid components under real-world conditions,
- Use of contemporary engineering mechanics 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,
- The ability to be effective interdisciplinary team members and leaders,
- Skills to be independent life-long learners while knowing when to seek help, and
- 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 Engineering Mechanics you can get an Air Force assignment as an aeronautical engineer, civil engineer, astronautical engineer, mechanical engineer, or project engineer. The Engineering Mechanics 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.

If you are a top performer in the Engineering Mechanics 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 Engineering Mechanics major gives you the flexibility to pursue either a more specialized degree in graduate school or to continue your broad-based study in engineering mechanics. Whether you ultimately choose a graduate program in aeronautical engineering, mechanical engineering, astronautical engineering, materials engineering, or engineering mechanics, your decision will be an informed one.

For more information on the engineering mechanics curriculum, please look up our home page at http://www.usafa.af.mil/dfem.

COURSE REQUIREMENTS: 147 Semester Hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
El Engr 231	Electrical Circuits and Systems I	El Engr 215
Math 356	Probability and Statistics for Engineers and Scientists	Math 300
Mech Engr 312	Thermal Fluids Systems Engineering I	Systems Option

B. *5 Semester hours of Director of Athletics courses.*

C. *3 Semester hours of Academy Option.*

D. *No Foreign Language courses required.*

E. *48 Semester hours of major's courses:*

1. Math 243 (or Math 253) Calculus III (or Advanced Placed Calculus III)
2. Math 245 Differential Equations
3. Math 346 Engineering Math

4. Engr Mech 320 Dynamics
5. Engr Mech 330 Mechanics of Deformable Bodies
6. Engr Mech 332 Aerospace Structures
7. Engr Mech 340 Materials Science for Engineers
8. Engr Mech 350 Mechanical Behavior of Materials
9. Engr Mech 460 Experimental Mechanics
10. Mech Engr 341 Thermal Fluids Systems Engineering II
11. Mech Engr 491 First-Class Capstone Design Project I
12. Mech Engr 492 First-Class Capstone Design Project II
13. Engineering Option (See Supplemental Information 1)
14. Engineering Option (See Supplemental Information 1)
15. Engr Mech Option (See Supplemental Information 2)
16. Engr Mech Option (See Supplemental Information 2)

Supplemental Information:

1. An Engineering Option (choose 2) is any one of the following courses that has not been used to satisfy another curriculum requirement. These courses emphasize traditional Engineering specialty areas as indicated. Additionally, an Independent Study (Engr Mech 499 or Mech Engr 499) may satisfy one of these options with department approval**.**

Mechanics and Materials	Engr Mech 421 (S)	Vibrations *Prereq*: Engr Mech 320 or Physics 355 *Coreq*: Math 346
	Engr Mech 431 (B)	Introduction to Finite Element Analysis *Prereq*: Engr Mech 330, Math 346
	Engr Mech 432 (S)	Finite Element Analysis *Prereq*: Engr Mech 431
	Engr Mech 440 (F)	Physical Metallurgy *Prereq*: Engr Mech 340
	Engr Mech 445 (S)	Failure Analysis and Prevention *Prereq*: Engr Mech 350 *Recommended Prereq*: Engr Mech 340, Engr Mech 440
	Engr Mech 450 (F)	Aerospace Composite Materials *Prereq*: Engr Mech 330, Math 245
Systems Modeling and Design	Mech Engr 325 (F)	Engineering System Dynamics *Prereq*: Engr Mech 320, El Engr 231 *Coreq*: Math 346
	Mech Engr 370 (S)	Introduction to Machine Design *Prereq*: Engr Mech 330, Engr Mech 320 *Recommended Prereq*: Engr Mech 350
	Mech Engr 396 (F)	Mechatronics *Prereq*: El Engr 231 (≥ B-), Engr Mech 330
	Mech Engr 490 (F)	Automotive Systems Analysis for the Engineer *Prereq*: Engr Mech 320
Flight Mechanics	Aero Engr 351 (F)	Aircraft Performance and Static Stability *Prereq*: Aero Engr 315, Math 245 *Coreq*: Astro Engr 310
	Aero Engr 456 (B)	Flight Test Techniques *Prereq*: Aero Engr 351 and Department (DFAN) Permission

(F) – Fall only, (S) – Spring only, (B) – both

2. An Engr Mech Option (choose 2) gives the cadet a choice of furthering his/her depth and/or breadth in Engineering Mechanics. It may be any one of the following courses that has not been used to satisfy another curriculum requirement.

Engr Mech 421 (S)	Vibrations *Prereq*: Engr Mech 320 or Physics 355 *Coreq*: Math 346
Engr Mech 431 (B)	Introduction to Finite Element Analysis *Prereq*: Engr Mech 330, Math 346
Engr Mech 440 (F)	Physical Metallurgy *Prereq*: Engr Mech 340
Engr Mech 445 (S)	Failure Analysis and Prevention *Prereq*: Engr Mech 350 *Recommended Prereq*: Engr Mech 340, Engr Mech 440
Engr Mech 450 (F)	Aerospace Composite Materials *Prereq*: Engr Mech 330, Math 245

3. Engr Mech 120 should be taken in the second semester, but definitely NLT the third semester.

SUGGESTED COURSE SEQUENCE

Engineering Mechanics Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Chem 141	3	2	Math 243	3	1				Engr Mech 460	3	2
	History 101	3	1	**Econ 200**	2	1	Engr Mech 350	3	1	Mech Engr 491	3	2
Fall	**Comp Sci 110**	3	1	**Mgt 200**	2	1	Math 346	3	1	Engineering Opt 1	3	1
	Math 141	3	1	**Civ Engr 210**	3	1	**Mech Engr 312**	3	1	Engr Mech Opt 1	3	1
	Engr 100	3	1	**Beh Sci 110**	3	1	**Beh Sci 310**	3	1	**English 411**	3	1
	Phy Ed	0.5	2	**Physics 215**	3	2	**Biology 215**	3	2	**Philos 310**	3	1
				Soc Sci 112	3	1	**Aero Engr 315**	3	1	*Phy Ed*	0.5	2
				Phy Ed	1	2	*Phy Ed*	1	2			
		15.5	8		20	10		19	9		18.5	10
	Physics 110	3	2	Engr Mech 330	3	1	Engr Mech 340	3	1	Mech Engr 492	3	2
	Chem 142	3	2	Math 245	3	1	Mech Engr 341	3	1	Engineering Opt 2	3	1
Spring	**Math 142**	3	1	Engr Mech 320	3	2	Engr Mech 332	3	1	Engr Mech Opt 2	3	1
	English 111	3	1	**English 211**	3	1	***Academy Option***	3	1	Engr 402	0.5	1
	Engr Mech 120	3	1	**El Engr 231**	3	1	**Law 220**	3	1	**Pol Sci 311**	3	1
	MSS 100	3	1	**History 202**	3	1	**Math 356**	3	1	**Astro Engr 310**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	**MSS 400**	3	1
		18.5	10		18.5	9		18.5	8	*Phy Ed*	0.5	2
											19	10

Course Unit Summary
Core (31)
Major (16)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy Options =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

ENGLISH

THE ENGLISH MAJOR AT A GLANCE: 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 will 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.

What is the curriculum like for an English major? 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 will be able to pattern a curriculum suited to your desires--one that's sure to enrich your intellectual life. For those cadets 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.

Whom should you talk to about the English major? 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. For more information, contact the English AIC or Assistant AIC at 3-2730.

COURSE REQUIREMENTS: 147 Semester hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
English 341	Literary Criticism	English 211
English 370	Speech Communication: Theory and Practice	English 411
Geog 310	Geospatial Information Analysis	Systems Option

B. *5 Semester hours of Director of Athletics courses.*

C. *12 Semester hours of Foreign Language.*

D. *3 Semester hours of Academy Option.*

E. *36 Semester hours of major's courses:*

1. English 341 Literary Criticism (Note 1)
2. English 353 Shakespeare
3. English 461 British Literature to 1780
4. English 462 British Literature 1780 - Present
5. English 471 American Literature to 1865
6. English 472 American Literature 1865 - Present

7-11. English Options (Choose five):
- Any English course
- Any Foreign Language course beyond core
- Area Stu 495
- Law 360
- Mgt 440
- History 320 or higher
- Fine Art 375 or higher
- Philos 330 or higher

12. English 490 First Class Seminar

Note: English 341 is a foundational course. Take as early as possible, but NLT the 6th semester.

SUGGESTED COURSE SEQUENCE

English Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
Fall	**Chem 141**	3	2	**English 211**	3	1	English 461	3	1	English 471	3	1
	Comp Sci 110	3	1	**Physics 110**	3	2	English Option I	3	1	English Option III	3	1
	English 111	3	1	**Beh Sci 110**	3	1	**Pol Sci 311**	3	1	English Option IV	3	1
	Math 141	3	1	**Soc Sci 112**	3	1	**El Engr 215**	3	1	**Beh Sci 310**	3	1
	Foreign Lang I	3	2	**Engr Mech 120**	3	1	**Biology 215**	3	2	**Aero Engr 315**	3	1
	Phy Ed	0.5	2	**Foreign Lang III**	3	1	**Civ Engr 210**	3	1	**Geog 310**	3	1
				Phy Ed	1	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		15.5	9		19	9		18.5	9		18.5	8
Spring	**Chem 142**	3	2	English 341	3	1	English 462	3	1	English 472	3	1
	Math 142	3	1	**Law 220**	3	1	English 353	3	1	English 490	3	1
	Engr 100	3	1	**Physics 215**	3	2	English Option II	3	1	English Option V	3	1
	History 101	3	1	**Mgt 200**	2	1	**Philos 310**	3	1	***Academy Option***	3	1
	MSS 100	3	1	**Econ 200**	2	1	**Math 300**	3	1	**Astro Engr 310**	3	1
	Foreign Lang II	3	2	**History 202**	3	1	**English 370 (for 411)**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	**Foreign Lang IV**	3	1	*Phy Ed*	1	2	*Phy Ed*	0.5	2
				Phy Ed	0.5	2						
		18.5	10		19.5	10		19	8		18.5	8

Course Unit Summary
Core (31)
Major (12)
Foreign Language (4)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	36.0	"
Foreign Language =	12.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

ENVIRONMENTAL ENGINEERING

THE ENVIRONMENTAL ENGINEERING MAJOR AT A GLANCE: 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 cadets a broad environmental engineering education. Cadets 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 USAFA 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 the Accreditation Board for Engineering and Technology. Upon graduation you earn a Bachelor of Science in Environmental Engineering.

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

The goals of the Environmental Engineering Program are to prepare cadets to become Air Force Officers who:

- Possess breadth of integrated, fundamental knowledge in the basic sciences, engineering, humanities, and social sciences; and depth of knowledge in environmental engineering 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 USAF core values, and
- Can function effectively in contingency operations.

The *Program Operational Goals* above describe what the Air Force would like to see in our graduates two to three years into their careers as Air Force Engineering Officers. To best support these goals our program's curriculum is designed such that, by graduation, our graduates possess certain qualities or outcomes. These *Program Curricular Outcomes*, listed below, call for our graduating cadets to satisfactorily demonstrate:

- 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 an independent learner while knowing when to seek help,
- Knowledge of the role of Air Force engineering officers in our global society, and
- Knowledge of contemporary social, economic, political, military, and engineering issues.

COURSE REQUIREMENTS: 147 Semester hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
El Engr 231	Electrical Circuits and Systems I	El Engr 215
Math 356	Probability and Statistics for Engineers and Scientists	Math 300
Mech Engr 312	Thermal Fluids Engineering I	Systems Option

B. *5 Semester hours of Director of Athletics' courses.*

C. 3 *Semester hours of Academy Option.*

D. *No Foreign Language courses required.*

E. *48 Semester hours of major's courses:*

1. Math 243 (or Math 253) Calculus III (or Advanced Placed Calculus III)
2. Math 245 Differential Equations
3. Civ Engr 330 Elementary Structural Analysis
4. Civ Engr 351 Civil Engineering Practices - Field Engineering
5. Civ Engr 361 Fundamental Hydraulics
6. Civ Engr 362 Introduction to Environmental Engineering
7. Civ Engr 368 Hazardous Waste Management and Contaminant Transport
8. Civ Engr 369 Introduction to Air Pollution
9. Civ Engr 390 Introduction to Soil Mechanics
10. Civ Engr 463 Wastewater Treatment Plant Design
11. Civ Engr 467 Water Treatment Principles and Design

12. Civ Engr 468	Solid and Hazardous Waste Facilities Design
13. Civ Engr 469	Design of Air Pollution Controls
14. Civ Engr 480	Project Management and Contract Administration
15. Civ Engr 405	First-Class Seminar
16. Biology/Chemistry/Physics Option	(See Supplemental Information #1)
17. Engineering/Basic Sciences Option	(See Supplemental Information #2)

Supplemental Information:

1. The Biology/Chemistry/Physics Option must be one of the following courses:

Biology 380	Principles of Ecology
Biology 431	Microbiology
Chem 222	Analytical Chemistry
Chem 230/233	Introductory Organic Chemistry/Organic Chemistry I
Chem 335	Introductory Physical Chemistry
Chem 381	Chemistry of the Environment
Physics 310	Principles of Nuclear Engineering

2. An Engineering/Basic Sciences Option is any course of at least three semester hours taught by either the Engineering Sciences Division or the Basic Sciences Division that has not been used to satisfy any other curriculum requirement. Remedial courses may not be used to satisfy this option. For a Basic Sciences Option, any course taught by the departments listed below may satisfy this option.

Department of Biology
Department of Chemistry
Department of Mathematical Sciences
Department of Physics

Additionally, Geog 310, Geog 360, or Geog 382 may be used to satisfy this option.

Note: Although the Department of Computer Science is part of the Basic Sciences Division, Computer Science courses cannot be taken to fulfill this option due to ABET requirements.

SUGGESTED COURSE SEQUENCE

Environmental Engineer Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
Fall	**Chem 141**	3	2	Math 243	3	1	Civ Engr 361	3	1	Civ Engr 369	3	1
	History 101	3	1	**Biology 215**	3	2	Civ Engr 362	3	1	Civ Engr 463	3	1
	English 111	3	1	**Engr Mech 120**	3	1	Civ Engr 390	3	1	Civ Engr 468	3	1
	Math 141	3	1	**English 211**	3	1	**El Engr 231**	3	1	**Beh Sci 310**	3	1
	Engr 100	3	1	**Physics 215**	3	2	**Pol Sci 311**	3	1	**Mech Engr 312***	3	1
				Soc Sci 112	3	1	**Aero Engr 315**	3	1	**English 411**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
		15.5	8		19	10		19	8		18.5	8
Spring	**Physics 110**	3	2	Civ Engr 330	3	1	Civ Engr 368	3	1	Civ Engr 467	3	1
	Chem 142	3	2	Math 245	3	1	Bio/Chem Option	3	1	Civ Engr 469	3	1
	Math 142	3	1	Engr/Bas Sci Opt	3	1	**Astro Engr 310**	3	1	Civ Engr 480	3	1
	Comp Sci 110	3	1	**History 202**	3	1	**Math 356**	3	1	Civ Engr 405	0	1
	Beh Sci 110	3	1	**Civ Engr 210**	3	1	**Law 220**	3	1	Civ Engr 351 (summer)	3	1
	MSS 100	3	1	**Mgt 200**	2	1	**Philos 310**	3	1	***Academy Option***	3	1
	Phy Ed	0.5	2	**Econ 200**	2	1	Phy Ed	0.5	2	**MSS 400**	3	1
				Phy Ed	0.5	2				*Phy Ed*	0.5	2
		18.5	10		19.5	9		18.5	8		18.5	9

Course Unit Summary
Core (31)
Major (16)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

FOREIGN AREA STUDIES

THE FOREIGN AREA STUDIES MAJOR AT A GLANCE: 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, geography, 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 Degree in: African Area Studies, Latin American Area Studies, European Area Studies, Asian Area Studies, Middle Eastern Area Studies, or Slavic Area Studies. Foreign Area Studies majors will select a disciplinary emphasis (Economics, History, Geography, or Political Science) which will determine which methods course, capstone course, and electives they take. In addition, Foreign Area Studies majors may earn an academic minor in a foreign language.

COURSE REQUIREMENTS: 147 Semester Hours

A. 91 *Semester hours of Dean's academic core courses.*

B. *5 Semester hours of Director of Athletics core courses.*

C. *12 Semester hours of Foreign Language.*
(Cadets must complete a minimum of 4 courses at the 200-level or higher)

D. 3 *Semester hours of Academy Option.*

E. 36 *Semester hours of majors' courses:*

1. Foreign Language course	Minor
2. Foreign Language course	Minor
3. Macroeconomic Principles	Econ 301
4. Regional History	History 340/342/344/346/373/374
5. Regional History	History 341/343/345/347/375/499
6. Comparative Politics	Pol Sci 394
7. Regional Politics	Pol Sci 469/471/473/475/477/479
8. Regional Geography	Geog 470/471/475/480
9. Comparative Economics	Econ 351/374/454/457/459
10. Research Methods	History 330, Geog 442, or Pol Sci 300
11. Capstone	History 498, Pol Sci 491, Geog 498, or another course approved by the FAS Working Group

12. One additional course from the following electives (either a ForArStu course or from the selected academic discipline):

Econ 459(Latin America)	For Lang 372 (Cultures)	History 499 (Area Related)
Econ 495 (Special Topic)	For Lang 376 (Literature)	Law 461 (Int'l Law)
Econ 499 (Indep Study)	For Lang 491 (Adv Readings)	Philos 401 (Comp Religion)
ForArStu 400 (Lg Immersion)	For Lang 492 (For AFA Prep)	Pol Sci 396 (US For Policy)

ForArStu 410 (MAL)	For Lang 495 (Special Topic)	Pol Sci 421 (Pol Violence)
ForArStu 420 (MOAS)	Geog 350 (Human Geog)	Pol Sci 423 (Human Rights)
ForArStu 430 (MOAU)	Geog 495 (Area Related)	Pol Sci 444 (Int'l Pol Econ)
ForArStu 440 (MNATO/EU)	Geog 499 (Area Related)	Pol Sci 445 (Int'l Orgs)
ForArStu 470 (20th C France)	German 370 (Ger Immigration)	Pol Sci 460 (Cmp Sec Policy)
ForArStu 495 (Special Topic)	History 363 (Unconv Warfare)	Pol Sci 495 (Area Related)
For Lang 321 (Advanced)	History 495 (Area Related)	Pol Sci 499 (Area Related)
For Lang 365 (Civilization)		Spanish 371 (Current Events)

NOTES:

1. Foreign Area Studies majors may also take as the elective any course which appears on the "Course Requirements" list under letter "E" above not used to fill another requirement.
2. Cadets not using their Academy Option for Academy Flight Screening, Soaring IP Upgrade, or Jumpmaster/Instructor Training are encouraged to use this option for an additional ForArStu elective course.

SUGGESTED COURSE SEQUENCE

Foreign Area Studies Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
Fall	**Chem 141**	3	2	**Physics 110**	3	2	Research Methods	3	1	Regional Poli Sci	3	1
	English 111	3	1	**Soc Sci 112**	3	1	Regional History I	3	1	Regional Economics	3	1
	Math 141	3	1	**Beh Sci 110**	3	1	**Foreign Lang V**	3	1	**Beh Sci 310**	3	1
	Comp Sci 110	3	1	**English 211**	3	1	Econ 301	3	1	**Philos 310**	3	1
	Foreign Lang I	3	2	**Engr Mech 120**	3	1	**Biology 215**	3	2	**Astro Engr 310**	3	1
				Foreign Lang III	3	1	**El Engr 215**	3	1	**Geog 310**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
		15.5	9		19	9		19	9		18.5	8
Spring	**History 101**	3	1	**Law 220**	3	1	Regional History II	3	1	Regional Geography	3	1
	Math 142	3	1	**Math 300**	3	1	Pol Sci 394	3	1	ForArStu Elective	3	1
	Engr 100	3	1	**Physics 215**	3	2	**Foreign Lang VI**	3	1	ForArStu Capstone	3	1
	Chem 142	3	2	**Mgt 200**	2	1	**Civ Engr 210**	3	1	***Academy Option***	3	1
	MSS 100	3	1	**Econ 200**	2	1	**Pol Sci 311**	3	1	**English 411**	3	1
	Foreign Lang II	3	2	**History 202**	3	1	**Aero Engr 315**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	**Foreign Lang IV**	3	1	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
				Phy Ed	0.5	2						
		18.5	10		19.5	10		18.5	8		18.5	8

Course Unit Summary
Core (31)
Major (12)
Foreign Language (4)
Academy Option (1)
Phys Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	36.0	"
Foreign Language=	12.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

For Lang 221, 222 and 223 must be taken in sequence (cannot be taken concurrently)

SUMMARY:

US 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 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 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.

FOREIGN LANGUAGE MINOR

WHAT LANGUAGES ARE TAUGHT AT USAFA? You may study Arabic, Chinese, French, German, Japanese, Russian, or Spanish--seven of the most important languages in the world. Within each language there is a broad spectrum of courses. The 100-200 level courses and Foreign Language 321 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. The following courses comprise the curriculum of the Department of Foreign Languages (DFF):

SKILLS DEVELOPMENT COURSES

For Lang 131/132	Introduction to the Language, Culture, and Civilization
For Lang 141/142	Accelerated Basic: Foundational Language, Culture and Civilization
For Lang 221	Intermediate I: Refinement of Language Skills
For Lang 222	Intermediate II: Continued Development of Language Skills
For Lang 223	Intermediate III: Focus on Conversational Practice
For Lang 321	Advanced: Capstone Course for Skills Development

ENHANCEMENT COURSES

For Lang 365	Civilization and Culture (contemporary issues)
For Lang 370	Specialized courses in German, French, Spanish and Japanese
For Lang 376	Introduction to Literature
For Lang 491	Specialized Language Course (advanced readings)
For Lang 492	Semester Exchange Program Preparation
For Lang 495	Special Topics
For Lang 499	Independent Study (normally offered only to those students who have completed all courses)

Note: Enhancement courses may be taken out of sequence with DFF approval.

The chart below clarifies the foreign language course sequences:

Language	**Courses**						
French							
German							
Arabic							
Chinese	**131**	**132**	**221**	**222**	**223**	**321**	
Japanese							
Russian							
French							
German	**141**	**142**		**222**	**223**	**321**	**365**
Spanish							

COURSE REQUIREMENTS FOR THE FOREIGN LANGUAGE MINOR: Cadets majoring in any academic division or discipline may earn a minor provided they complete four language courses beyond the 100-level, in residence, in the same language with a grade of 'C' or better and complete the requirements for their major.

HOW CAN I BENEFIT FROM FOREIGN LANGUAGE STUDY? 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 USAFA as a language instructor, a position that is both rewarding and career enhancing while providing the opportunity to influence other cadets 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.

WHY STUDY A FOREIGN LANGUAGE? "Americans' scandalous incompetence in foreign languages explains our dangerously inadequate understanding of world affairs. Our schools graduate a large majority of students whose knowledge and vision stop at the American shoreline, whose approach to international affairs is provincial, whose heads have been filled with astonishing misinformation....The United States requires far more reliable capacities to communicate."

The quotation above is from the President's Commission on Foreign Languages and International Studies and underscores the importance of foreign language. Learning a foreign language at USAFA 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. Here are other important quotes:

"Just as we were ill-equipped to deal with the technological threats of the Cold War era, today we lack the linguistic and cultural skills and resources fundamental to competing in the new international environment."—Former Senator David Boren (D-OK), Chairman, Senate Inteligence Committee

"In the post-Cold War world, the most important distinctions between peoples are no longer ideological, political, or economic. The distinctions are cultural."—Samuel P. Huntington

"We need policy-makers, diplomats, and intelligence analysts expert in cultures and languages that encompass all regions of the world."—Former Senator Sam Nunn

GEOGRAPHY

THE GEOGRAPHY MAJOR AT A GLANCE: The Geography major offers a diverse and challenging program focusing on contemporary world problems. A flexible curriculum has been carefully designed to permit either an in-depth or cross-disciplinary approach to the study of geography, maximizing a cadet's ability to design his/her academic program beyond the core disciplinary requirements. Course offerings within the discipline represent an excellent cross-section of the key geographic 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, cadets who wish to complement their major in Geography with a foreign language minor will usually be able to achieve both without carrying an overload of academic courses.

The Geography major provides excellent preparation for any assignment in the Expeditionary Air Force. The Geography major provides a foundation for understanding cultures and operating anywhere in the Battlespace. About 70% of Geography majors use their education as pilots or intelligence officers. Many of the intelligence officers progress to become Foreign Area Officers.

COURSE REQUIREMENTS: 147 Semester hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternate:*

Required Core Alternate		**Substitutes for**
Geog 310	Geospatial Information Analysis	Systems Option

B. *5 Semester hours of Director of Athletics courses.*

C. 3 *Semester hours of Academy Option*.

D. *12 Semester hours of Foreign Language*.

E. *36 Semester hours of major's courses:*

1. Geog 350 — Human Geography
2. Geog 351 — Introduction to Physical Geography
3. Geog 370 — Military Geography
4. Geog 382 — Remote Sensing and Imagery Analysis
5. Geographic Research Methods (select one)
   - Geog 355 — Field Methods in Geography
   - Geog 442 — Seminar in Geographic Research
6. Physical Geography Option (select one)
   - Geog 353 — Geomorphology
   - Geog 360 — Environmental Geography
7. Human Geography Option (select one)

Geog 470 Geography of Europe and Russia
Geog 471 Geography of the Americas
Geog 475 Geography of Asia
Geog 480 Geography of the Middle East and Africa

8. – 11. Geography/Cognate Elective (See Supplemental Information)
12. Academic Division Option

Supplemental Information

LIST OF APPROVED GEOGRAPHY/COGNATE ELECTIVES

Geog 353	Biology 330	Econ 457	History 351	Pol Sci 390
Geog 355	Biology 331	History 325	History 352	Pol Sci 421
Geog 360	Biology 380	History 332	History 367	Pol Sci 444
Geog 470	Biology 481	History 335	History 368	Pol Sci 445
Geog 471	Civ Engr 215	History 336	History 369	Pol Sci 460
Geog 475	Civ Engr 362	History 338	History 370	Pol Sci 462
Geog 480	Civ Engr 368	History 340	History 372	Pol Sci 465
Geog 495	Civ Engr 369	History 341	History 374	Pol Sci 469
Geog 498	Civ Engr 390	History 342	History 375	Pol Sci 471
Geog 499	Comp Sci 225	History 343	History 376	Pol Sci 473
Meteor 320	Econ 332	History 344	History 377	Pol Sci 475
Meteor 352	Econ 351	History 345	History 480	Pol Sci 477
Beh Sci 350	Econ 355	History 346	Philos 401	Pol Sci 479
Beh Sci 352	Econ 374	History 347	Philos 402	Physics 371
Beh Sci 360	Econ 451	History 351	Law 330	
Math 243	Econ 454		Law 461	
Math 253			Law 371	
Math 245				
Any language course beyond the four-semester requirement				

SUGGESTED COURSE SEQUENCE

Geography Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Math 141	3	1	**Engr Mech 120**	3	1	Geog 351	3	1	Geog/Cognate Elective	3	1
	Chem 141	3	2	**Civ Engr 210**	3	1	Geog 370	3	1	Geog/Cognate Elective	3	1
Fall	**English 111**	3	1	**Soc Sci 112**	3	1	**Geog 310**	3	1	Geog Research Option	3	1
	Comp Sci 110	3	1	**Beh Sci 110**	3	1	**Biology 215**	3	2	**Beh Sci 310**	3	1
	Foreign Lang I	3	2	**Physics 110**	3	2	**Electrical Engr 215**	3	1	**Astro Engr 310**	3	1
	Phy Ed	0.5	2	**Foreign Lang III**	3	1	**Poli Sci 311**	3	1	**English 411**	3	1
		15.5	9	*Phy Ed*	1	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
					19	9		19	9		18.5	8
	Math 142	3	1									
	Chem 142	3	2	**Econ 200**	2	1	Geog 382	3	1	Human Geog Option	3	1
	MSS 100	3	1	**English 211**	3	1	Physical Geog Option	3	1	Geog/Cognate Elective	3	1
Spring	**History 101**	3	1	**Mgt 200**	2	1	**Law 220**	3	1	Geog/Cognate Elective	3	1
	Engr 100	3	1	**History 202**	3	1	**Math 300**	3	1	Acad Division Option	3	1
	Foreign Lang II	3	2	**Physics 215**	3	2	**Philos 310**	3	1	***Academy Option***	3	1
	Phy Ed	0.5	2	Geog 350	3	1	**Aero Engr 315**	3	1	**MSS 400**	3	1
				Foreign Lang IV	3	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		18.5	10	*Phy Ed*	0.5	2						
					19.5	11		18.5	8		18.5	8

Course Unit Summary
Core (31)
Major (12)
Foreign Lang (4)
Academy Options (1)
Phy Ed (10)

Semester Hour Summary

Core =	**91.0**	Sem Hours
Major =	36.0	"
Foreign Lang =	12.0	"
Academy Options =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	**"**

HISTORY

THE HISTORY MAJOR AT A GLANCE: 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 cadets 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.

COURSE REQUIREMENTS: 147 Semester Hours

A. *91 Semester hours of Dean's academic core courses.*

Required Core Alternate		**Substitutes for**
Geog 310	Geospatial Information Analysis	Systems Option

B. *5 Semester hours of Director of Athletics courses.*

C. *12 Semester hours of Foreign Language.*

D. *3 Semester hours of Academy Option.*

E. *36 semester hours of major's courses:*

1. History 330	Historiography and Methodology
2. History 351	The Foundations of Modern America
3. History 352	The History of Modern America
4. AeroSpace History Option	(See Supplemental Information #1)
5. Area History Option	(See Supplemental Information #2)
6-10. History Options	(See Supplemental Information #3)
11. History Capstone	(See Supplemental Information #4)
12. Open Academic Option	(See Supplemental Information #5)

Supplemental information:

1. AeroSpace History Option: Any course from the following list fulfills this requirement:

History 371	Airpower and Modern Warfare
History 376	A History of Space Power

2. Area History Option: Any course from the following list fulfills this requirement:

History 340	History of Colonial Latin America
History 341	History of Modern Latin America
History 342	History of Traditional East Asia
History 343	History of Modern East Asia
History 344	Foundations of European History
History 345	Modern European History
History 346	History of Russia
History 347	History of Modern Russia
History 373	History of Sub-Sharan Africa
History 374	Foundations of Middle Eastern History
History 375	Modern Middle Eastern History

3. History Options: Select any five history courses from the Curriculum Handbook. To achieve a Military History designation on your transcript, four of the five must be Military History courses. To achieve an American History designation on your transcript, four of the five must be American History courses.

4. History Capstone:

For an American History Major:	History 480	Studies in American Civilization
For a Military History Major:	History 457	History of Military Thought
For a History Major:	History 498	Global Dimensions of History

5. Open Academic Option: Any course offered by the Basic Sciences, Engineering, Social Sciences, or Humanities divisions.

SUGGESTED COURSE SEQUENCE

History Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Chem 141	3	2	**Physics 110**	3	2	Aerospace Hist Option	3	1	Capstone Option	3	1
	History 101	3	1	**Soc Sci 112**	3	1	History 351	3	1	History Option #3	3	1
Fall	**English 111**	3	1	**Beh Sci 110**	3	1	History Option #1	3	1	**Beh Sci 310**	3	1
	Math 141	3	1	**History 202**	3	1	**El Engr 215**	3	1	**English 411**	3	1
	Foreign Lang I	3	2	**Engr Mech 120**	3	1	**Biology 215**	3	2	**Aero Engr 315**	3	1
				Foreign Lang III	3	1	**Pol Sci 311**	3	1	**Geog 310**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
		15.5	9		19	9		19	9		18.5	8
	Chem 142	3	2	History 330	3	1	History 352	3	2	History Option #4	3	1
	Math 142	3	1	**English 211**	3	1	Area History Option	3	1	History Option #5	3	1
Spring	**Engr 100**	3	1	**Physics 215**	3	2	History Option #2	3	1	Academic Div Option	3	1
	MSS 100	3	1	**Mgt 200**	3	1	**Philos 310**	3	1	***Academy Option***	3	1
	Comp Sci 110	3	1	**Econ 200**	2	1	**Math 300**	3	1	**Astro Engr 310**	3	1
	Foreign Lang II	3	2	**Civ Engr 210**	2	1	**Law 220**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	**Foreign Lang IV**	3	1	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
				Phy Ed	0.5	2						
		18.5	10		19.5	10		18.5	9		18.5	8

Course Unit Summary
Core (31)
Major (12)
Foreign Language (4)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	36.0	"
Foreign Language =	12.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

LEGAL STUDIES

THE LEGAL STUDIES MAJOR AT A GLANCE: The Legal Studies major provides a broad liberal arts background upon which a cadet at the United States Air Force 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. Cadets 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 "pre-law" major, but is designed to provide cadets 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. Cadets who elect to major in Legal Studies must complete four Foreign Language courses and nine courses specifically offered by the Department of Law. In addition, a Legal Studies major has discretion in selecting courses offered by the Departments of Economics and Geography, Philosophy, and Political Science. 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.

COURSE REQUIREMENTS: 147 Semester hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternate:*

Required Core Alternate		**Substitutes for**
Ops Rsch 310	Systems Analysis	Systems Option

B. *5 Semester hours of Director of Athletics courses.*

C. 3 *Semester hours of Academy Option.*

D. *12 Semester hours of Foreign Language.*

E. *36 Semester hours of major's courses:*

1. Law 221	Legal Research, Writing & Advocacy
2. Law 331	Crime & Criminal Justice
3. Law 351	U.S. Constitutional Law
4. Law 421	Law for Commanders
5. Law 485	Contemporary Problems & the Law
6. – 10. Law Options	Any five of the following courses:
Law 340	Business Law
Law 360	Law & Literature
Law 361	Modern Application of the Law of Armed Conflict

Law 371	Environmental Law & Policy
Law 456	National Security Law
Law 461	International Law
Law 495	Special Topics (when offered)
Law 499	Independent Study
Philos 360	Applied Reasoning
Philos 395	Philosophy of Law
Pol Sci 423	War Crimes, Genocide, & Human Rights
Pol Sci 465	U.S. National Space Policy & Law
Soc Sci 420	Law & Economics
Soc Sci 483	Principles of Negotiation and the Mediation Process

11. – 12. Any two Soc Sci/Hum 300/400-level courses.

SUGGESTED COURSE SEQUENCE

Legal Studies Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
				Physics 215	3	2	Law Option I	3	1	Law 421	3	1
	Chem 141	3	2	**History 101**	3	1	Law 331	3	1	Law Option IV	3	1
Fall	**Math 141**	3	1	**English 211**	3	1	**Pol Sci 311**	3	1	Soc Sci/Hum Option I	3	1
	English 111	3	1	**Engr Mech 120**	3	1	**El Engr 215**	3	1	**Beh Sci 310**	3	1
	Engr 100	3	1	**Law 220**	3	1	**Biology 215**	3	2	**Ops Rsch 310**	3	1
	Foreign Lang I	3	2	**Foreign Lang III**	3	1	**Civ Engr 210**	3	1	**English 411**	3	1
	Phy Ed	0.5	2	Phy Ed	1	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
		15.5	9		19	9		19	9		18.5	8
	Chem 142	3	2	Law 221	3	1	Law Option II	3	1	Law 485	3	2
	Math 142	3	1	**Soc Sci 112**	3	1	Law Option III	3	1	Law Option V	3	1
Spring	**Comp Sci 110**	3	1	**History 202**	3	1	Law 351	3	1	Soc Sci/Hum Option II	3	1
	Physics 110	3	2	**Beh Sci 110**	3	1	**Philos 310**	3	1	***Academy Option***	3	1
	MSS 100	3	1	**Mgt 200**	2	1	**Math 300**	3	1	**Astro Engr 310**	3	1
	Foreign Lang II	3	2	**Econ 200**	2	1	**Aero Engr 315**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	**Foreign Lang IV**	3	1	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
				Phy Ed	0.5	2						
		18.5	11		19.5	9		18.5	8		18.5	9

Course unit summary:
Core (31)
Major (12)
Foreign Language (4)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	36.0	"
Foreign Language =	12.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

MANAGEMENT

THE MANAGEMENT MAJOR AT A GLANCE: The Management major prepares cadets for management and leadership roles in today's technologically complex, global Air Force. The curriculum is designed to develop cadets who can understand, analyze, and improve organizations through the efficient and effective use of systems. The courses in the major help students 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 AACSB (Association to Advance Collegiate Schools of Business) and ranks among the most prestigious undergraduate management and business degrees in the nation. Our curriculum, together with the Academy's core courses, provide an excellent educational foundation for cadets interested in pursuing Air Force careers (AFSCs) such as *11XX (Pilot), 12XX (Navigator), 13BX (Air Battle Manager), 13S1 (Space and Missile Operations), 14N1 (Intelligence), 21A1 (Aircraft Maintenance), 21R1 (Logistics Readiness), 31P1 (Security Police), 33S1 (Communications and Information), 41AX (Health Services Administrator), 63A1 (Acquisition Manager), 64P1 (Contracting), 65F1 (Financial Management), 65W1 (Cost Analysis), and 71SX (Special Investigator).* Additionally, the Management major prepares cadets 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.

COURSE REQUIREMENTS: 147 Semester Hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternate:*

Required Core Alternate		**Substitutes for**
Ops Rsch 310	Systems Analysis	Systems Option

B. *5 Semester hours of Director of Athletics core courses.*

C. *3 Semester hours of Academy Option.*

D. *12 Semester hours of Foreign Language.*

E. *36 Semester hours of additional major's courses.*

1. Mgt 303 Management Perspectives
2. Mgt 341 Financial Accounting
3. Mgt 345 Human Managerial Systems I

4. Mgt 361 Human Managerial Systems II
5. Mgt 423 Managerial Economics
6. Mgt 437 Managerial Finance
7. Mgt 472 Strategic Management
8. Select one of the following 2° Mgt Options
   Law 340 Business Law
   Mgt 342 Managerial Accounting
   Mgt 375 Marketing
   Mgt 391 Management Information Systems
   Mgt 392 Electronic Commerce
9. Select one of the following 1° Mgt Options
   Mgt 440 Management Lessons in Literature
   Mgt 446 Organizational Theory
   Mgt 477 Production and Operations Management
   Mgt 498 International Management

10.-11. Select two Mgt Focus Options (an additional Mgt-prefix course)
12. Mgt Concentration Option (any Soc Sci division or MSS courses or Armnshp 425)
13. Foreign Language Option #1
14. Foreign Language Option #2
15. Foreign Language Option #3
16. Foreign Language Option #4
17. Academy Option
18. Mgt 405 Management Seminar

Supplemental Information:

The various option courses (2° Mgt Option, 1° Mgt Option, Mgt Focus Options, and Mgt Concentration Option) are chosen in consultation with the academic advisor.

SUGGESTED COURSE SEQUENCE

Management Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Math 141	3	1	**Physics 110**	3	2	Mgt 303	3	2	Mgt 437	3	1
	Chem 141	3	2	**Soc Sci 112**	3	1	Mgt 341	3	1	Mgt 423	3	1
Fall	**English 111**	3	1	**Mgt 200**	2	1	Mgt 345	3	2	Mgt Focus Option	3	1
	Beh Sci 110	3	1	**Econ 200**	2	1	**El Engr 215**	3	1	**Beh Sci 310**	3	1
	Foreign Lang I	3	2	**Engr Mech 120**	3	1	**Civ Engr 210**	3	1	**Astro Engr 310**	3	1
				Engr 100	3	1	**Pol Sci 311**	3	1	**Philos 310**	3	1
	Phy Ed	0.5	2	**Foreign Lang III**	3	1	*Phy Ed*	1	2	*Phy Ed*	0.5	2
				Phy Ed	1	2						
		15.5	9		20	10		19	10		18.5	8
										Mgt 472	3	1
	Math 142	3	1	**History 202**	3	1	Mgt 361	3	2	Mgt Focus Option	3	2
	Chem 142	3	2	**Law 220**	3	1	Mgt 2º Option	3	1	Mgt 1º Option	3	1
Spring	**History 101**	3	1	**Physics 215**	3	2	Mgt Concentration Opt	3	1	***Academy Option***	3	1
	Comp Sci 110	3	1	**Biology 215**	3	2	**Ops Rsch 310**	3	1	**MSS 400**	3	1
	MSS 100	3	1	**English 211**	3	1	**Aero Engr 315**	3	1	**English 411**	3	1
	Foreign Lang II	3	2	**Foreign Lang IV**	3	1	**Math 300**	3	1	Mgt 405	0	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		18.5	10		18.5	10		18.5	9		18.5	10

Course Unit Summary
Core (31)
Major (12)
Academy Option (1)
Foreign Language (4)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	36.0	"
Academy Option =	3.0	"
Foreign Languages=	12.0	"
Phy Ed =	5.0	
Total =	147.0	"

MATHEMATICAL SCIENCES

THE MATHEMATICAL SCIENCES MAJOR AT A GLANCE: We've designed the Mathematical Sciences major to teach you the problem solving and analytical skills you'll need to deal with the complex operational, management, engineering, and mathematical problems you'll encounter as an officer in the Air Force of today and tomorrow. You'll 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 you'll increase your ability to: a) logically analyze a problem, b) determine the tools required to formulate a solution, and c) develop and execute that solution. The key to the Mathematical Sciences major is flexibility. It allows you the flexibility to choose the areas you'll study. You'll have the opportunity to choose one of three specialty options allowing you to study the area of mathematics in which you have the most interest. Each specialty's open options can be filled with mathematics courses or courses offered by other departments. Should you declare a second major, you can substitute courses from your second discipline for your open options. The program also provides enormous flexibility in the opportunities that will be available to you as an Air Force officer. An officer with a background in mathematics has many different AFSCs from which to choose, such as space systems analyst, scientific analyst, experimental test pilot, acquisition project/program officer, information systems analyst, and intelligence applications officer. This list is certainly not exhaustive since it doesn't include any of the AF specialties with no specific degree requirements. You'll also have a firm foundation for graduate work in Operations Research, Physics, most Engineering disciplines, Business Administration, Economics, Computer Science, Law, Medicine, Meteorology, and, of course, Mathematics.

Most math majors declare during their third- or fourth-class years. However, occasionally a cadet who has already taken Math 243 (or Math 253) and Math 245 declares as late as the fall of his/her second-class year. It is recommended that cadets have a minimum 2.70 cum GPA before declaring the Mathematical Sciences major. If you have questions regarding the math major (the coursework, difficulty level, and graduate school/career opportunities) please stop by the Department of Mathematical Sciences and talk to the Advisor-in-Charge.

COURSE REQUIREMENTS: 147 Semester hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates*:

Required Core Alternate		**Substitutes for**
Math 377	Applied Probability and Statistics	Math 300

B. *5 Semester hours of Director of Athletics courses.*

C. *No Foreign Language courses required.*

D. *3 Semester hours of Academy Option.*

E. 27 *Semester hours of major's courses:*

1. Math 243 (or Math 253) Calculus III (or Advanced Placed Calculus III)
2. Math 245 Differential Equations
3. Math 320 Foundations of Mathematics
4. Math 342 Numerical Analysis with Differential Equations
5. Math 346 Engineering Math
6 Math 378 Advanced Probability and Statistics
7. Math 360 Linear Algebra
8. Math 366 Real Analysis I
9. Comp Sci 211 Programming for Scientists and Engineers
10. Math 405 First-Class Seminar

F. *21 Semester hours of courses in one of the options outlined below. Up to 6 semester hours can be foreign language courses. Additionally, courses such as Philos 370 and Comp Sci 431 can fulfill these requirements.*

Applied Mathematics Option

a. Non-Graduate School Option
   i. Two of**:**
      Math 374 Combinatorics and Graph Theory
      Math 451 Complex Variables
      Math 468 Dynamical Systems
      Math 469 Partial Differential Equations
      Math 470 Mathematical Physics
   ii. 15 semesters of additional work, coherently chosen, requiring approval of the Mathematical Sciences Advisor-in-Charge

b. Graduate School Option (required of all cadets pursuing the DFMS GSP under the Applied Mathematics Option)
   i. Must complete:
      Math 451 Complex Variables
      Math 469 Partial Differential Equations
   ii. Must accomplish one of:
      Math 467 Real Analysis II
      Math 468 Dynamical Systems
      Math 470 Mathematical Physics
      Math 495 Special Topics (Applied Mathematics)
   iii. 12 semester hours of additional work, coherently chosen, requiring approval of the Mathematical Sciences Advisor-in-Charge

Pure Mathematics Option

a. Non-Graduate School Option
   i. Two of**:**
      Math 370 Topology
      Math 372 Number Theory
      Math 374 Combinatorics and Graph Theory
      Math 451 Complex Variables

Math 465	Modern Algebra
Math 467	Real Analysis II

ii. 15 semesters of additional work, coherently chosen, requiring approval of the Mathematical Sciences Advisor-in-Charge

b. Graduate School Option (required of all cadets pursuing the DFMS GSP under the Pure Mathematics Option)

i. Must complete:

Math 451	Complex Variables
Math 465	Modern Algebra

ii. Must accomplish one of:

Math 370	Topology
Math 372	Number Theory
Math 467	Real Analysis II
Math 495	Special Topics (Pure Mathematics)

iii. 12 semester hours of additional work, coherently chosen, requiring approval of the Mathematical Sciences Advisor-in-Charge

Scientific Analyst Preparation Option

a. Three of:

Math 359	Design and Analysis of Experiments
Comp Sci 210	Introduction to Programming
Comp Sci 362	Computer Simulation
Ops Rsch 321	Probabilistic Models
Ops Rsch 411	Topics in Mathematical Programming

b. 12 semester hours of additional work, coherently chosen, requiring approval of the Mathematical Sciences Advisor-in-Charge

SUGGESTED COURSE SEQUENCE

Mathematical Sciences Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Math 141	3	1	Math 243	3	1	Math 346	3	1	Math 405	0	1
	History 101	3	1	**Civ Engr 210**	3	1	Math 360	3	1	Math Option	3	1
Fall	**Engr 100**	3	1	**Engr Mech 120**	3	1	Math Option	3	2	Math Option	3	1
	Chem 141	3	2	**Biology 215**	3	2	**Math 377**	3	1	Math Option	3	1
	Soc Sci 112	3	1	**Physics 110**	3	2	**Econ 200**	2	1	Math Option	3	1
				History 202	3	1	**Mgt 200**	2	1	**English 411**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	**Beh Sci 310**	3	1	**Philos 310**	3	1
							Phy Ed	1	2	*Phy Ed*	0.5	2
		15.5	8		19	10		20	10		18.5	9
	Math 142	3	1	Math 320	3	1	Math 342	3	1	Math Option	3	1
	Chem 142	3	2	Math 245	3	1	Math 366	3	1	Math Option	3	1
Spring	**English 111**	3	1	Comp Sci 211	3	1	Math 378	3	1	***Academy Option***	3	1
	Comp Sci 110	3	1	**English 211**	3	1	**El Engr 215**	3	1	**Energy/Sys Option**	3	1
	MSS 100	3	1	**Physics 215**	3	2	**Aero Engr 315**	3	1	**Astro Engr 310**	3	1
	Beh Sci 110	3	1	**Law 220**	3	1	**Pol Sci 311**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		18.5	9		18.5	9		18.5	8		18.5	8

Course Unit Summary
Core (31)
Major (16)
Academy Options (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy. Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

MECHANICAL ENGINEERING

THE MECHANICAL ENGINEERING MAJOR AT A GLANCE: If you want to design and build things, then you 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 are an automobile's fuel injected, electronic ignition power train; its 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 USAFA Mechanical Engineering degree is accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET).

The Goal of the Department of Engineering Mechanics, which administers the Mechanical Engineering Program, is to *Educate Engineers for the Military Profession*. The Mechanical Engineering program is specifically designed with the goal of generating:

- Officers who possess breadth of integrated, fundamental knowledge in engineering, the basic sciences, social sciences, and humanities; and depth of knowledge in mechanical engineering,
- Officers who communicate effectively,
- Officers who work effectively on teams and grow into team leaders,
- Officers who are independent learners, and (as applicable) successful in graduate school,
- Officers who can apply their knowledge and skills to solve Air Force engineering problems, both well- and ill-defined, and
- Officers who know and practice their ethical, professional, and community responsibilities as embodied in the USAF core values.

The *Program Operational Goals* listed above describe what the Air Force would like to see in our graduates as they begin their careers as Air Force Engineering Officers. To best support these goals, our program's curriculum is designed such that, by graduation, our graduates possess certain qualities or outcomes. These *Program Curricular Outcomes*, listed below, call for our graduating cadets to satisfactorily demonstrate:

- 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,

- The ability to be effective interdisciplinary team members and leaders,
- Skills to be independent life-long learners while knowing when to seek help, and
- 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 you can get an Air Force assignment as an aeronautical engineer, civil engineer, astronautical 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.

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, mechanical engineering, astronautical engineering, materials engineering, or engineering mechanics, your decision will be an informed one.

For more information on the Mechanical Engineering curriculum, please look up our home page at http://www.usafa.af.mil/dfem

COURSE REQUIREMENTS: 147 Semester Hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
El Engr 231	Electrical Circuits and Systems I	El Engr 215
Math 356	Probability and Statistics for Engineers and Scientists	Math 300
Mech Engr 312	Thermal Fluids Systems Engineering I	Systems Option

B. *5 Semester hours of Director of Athletics courses.*

C. *3 Semester hours of Academy Option.*

D. *No Foreign Language courses required.*

E. *48 Semester hours of major's courses:*

1. Math 243 (or Math 253) Calculus III (or Advanced Placed Calculus III)
2. Math 245 Differential Equations
3. Math 346 Engineering Math
4. Engr Mech 320 Dynamics
5. Engr Mech 330 Mechanics of Deformable Bodies

6. Engr Mech 350	Mechanical Behavior of Materials
7. Engr Mech 460	Experimental Mechanics (See Supplemental Information 1)
8. Mech Engr 325	Engineering System Dynamics
or Engr 341	Linear Systems Analysis and Design
9. Mech Engr 341	Thermal Fluids Systems Engineering II
10. Mech Engr 370	Introduction to Machine Design
11. Mech Engr 441	Thermal Fluids Systems Engineering III
12. Mech Engr 491	First-Class Capstone Design Project I
13. Mech Engr 492	First-Class Capstone Design Project II (See Supplemental Information 1)
14. Mech Engr Analysis Opt	(See Supplemental Information 2)
15. Mech Engr Option	(See Supplemental Information 3)
16. Mech Engr Option	(See Supplemental Information 3)

Supplemental Information:

1. If planning a focus in certain areas (Flight Mechanics, Propulsion, etc.), cadets may petition DFEM and other applicable departments for a waiver to substitute the capstone design sequence of another major.

2. The Mech Engr Analysis Option is any one of the following courses that has not been used to satisfy another curriculum requirement.

Aero Engr 342 (S)	Computational Aerodynamics *Prereq*: Aero Engr 341, Math 346
Engr 341 (F)	Linear Systems Analysis and Design *Prereq*: Math 245, El Engr 231
Engr Mech 421 (S)	Vibrations *Prereq*: Engr Mech 320 or Physics 355 *Coreq:* Math 346
Engr Mech 431 (B)	Introduction to Finite Element Analysis *Prereq*: Engr Mech 330, Math 346
Engr Mech 445 (S)	Failure Analysis and Prevention *Prereq*: Engr Mech 350, *Recommended:* Engr Mech 340, Engr Mech 440
Engr Mech 450 (F)	Aerospace Composite Materials *Prereq:* Engr Mech 330, Math 245
Mech Engr 396 (F)	Mechatronics *Prereq*: El Engr 231(≥ B-), Engr Mech 330
Mech Engr 467 (S)	Energy Conversion Pereq: MechEngr 441

Courses offered: (F) – Fall Only, (S) – Spring Only, (B) – Both Fall and Spring

3. A Mechanical Engineering Option (Choose 2) is any one of the following courses that has not been used to satisfy another curriculum requirement. As indicated, such courses will emphasize traditional Mechanical Engineering specialty areas. Additionally, an Independent Study (Engr Mech 499 or Mech Engr 499) may satisfy one of these options with department approval.

Mechanics and Materials	Engr Mech 332 (S)	Analysis and Design of Aerospace Structures *Prereq*: Engr Mech 330 *Coreq*: Aero Engr 315, Engr Mech 320

	Engr Mech 340 (S)	Materials Science for Engineers *Prereq*: Engr Mech 120
	Engr Mech 421 (S)	Vibrations *Prereq*: Engr Mech 320 or Physics 355 *Coreq*: Math 346
	Engr Mech 431 (B)	Introduction to Finite Element Analysis *Prereq*: Engr Mech 330, Math 346
	Engr Mech 432 (S)	Finite Element Analysis *Prereq*: Engr Mech 431
	Engr Mech 440 (F)	Physical Metallurgy *Prereq*: Engr Mech 340
	Engr Mech 445 (S)	Failure Analysis and Prevention *Prereq*: Engr Mech 350, *Recommended Prereq*: Engr Mech 340, Engr Mech 440
	Engr Mech 450 (F)	Aerospace Composite Materials *Prereq*: Engr Mech 330, Math 245
Systems Modeling and Design	Mech Engr 325 (F)	Engineering System Dynamics *Prereq*: Engr Mech 320, El Engr 231 *Coreq*: Math 346
	Mech Engr 396 (F)	Mechatronics Prereq: El Engr 231(≥ B-), Engr Mech 330
	Mech Engr 490 (F)	Automotive Systems Analysis for the Engineer *Prereq*: Engr Mech 320
Propulsion	Aero Engr 361 (S)	Propulsion I *Prereq*: Aero Engr 241 or department permission
	Aero Engr 466 (F)	Propulsion II *Prereq*: Aero Engr 361
	Astro Engr 351 (B)	Rocket Propulsion *Prereq*: Astro Engr 310, Aero Engr 241
Flight Mechanics	Aero Engr 342 (S)	Computational Aerodynamics *Prereq*: Aero Engr 341, Math 346
	Aero Engr 351 (F)	Aircraft Performance and Static Stability *Prereq*: Aero Engr 315, Math 245 *Coreq*: Astro Engr 310
	Aero Engr 442 (F)	Aerodynamics *Prereq*: Aero Engr 342
	Aero Engr 456 (B)	Flight Test Techniques *Prereq*: Aero Engr 351 and department (DFAN) permission
Controls	Engr 341 (F)	Linear Systems Analysis and Design *Prereq*: El Engr 231, Math 245
	Engr 342 (S)	Linear Control System Analysis and Design Prereq: Engr 341 or Mech Engr 325

(F) – Fall only, (S) – Spring only, (B) – both

4. Engr Mech 120 should be taken in the second semester, but NLT the third semester.

SUGGESTED COURSE SEQUENCE

Mechanical Engineering Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
Fall	**Chem 141**	3	2	Math 243	3	1	Engr Mech 350	3	1	Engr Mech 460	3	2
	History 101	3	1	**Mgt 200**	2	1	Math 346	3	1	Mech Engr 441	3	1
	Comp Sci 110	3	1	**Econ 200**	2	1	Mech Engr 325	3	1	Mech Engr 491	3	2
	Math 141	3	1	**Civ Engr 210**	3	1	**Mech Engr 312**	3	1	Mech Engr Option 1	3	1
	Engr 100	3	1	**Beh Sci 110**	3	1	**Beh Sci 310**	3	1	**English 411**	3	1
				Physics 215	3	2	**Biology 215**	3	2	**Philos 310**	3	1
	Phy Ed	0.5	2	**Soc Sci 112**	3	1	*Phy Ed*	1	2	*Phy Ed*	0.5	2
				Phy Ed	1	2						
		15.5	8		20	10		19	9		18.5	10
Spring	**Physics 110**	3	2	Engr Mech 330	3	1	Mech Engr 370	3	1	Mech Engr 492	3	2
	Chem 142	3	2	Math 245	3	1	Mech Engr 341	3	1	Mech Engr Analysis Opt	3	1
	Math 142	3	1	Engr Mech 320	3	2	***Academy Option***	3	1	Mech Engr Option 2	3	1
	English 111	3	1	**English 211**	3	1	**Aero Engr 315**	3	1	Engr 402	0.5	1
	Engr Mech 120	3	1	**El Engr 231**	3	1	**Law 220**	3	1	**Pol Sci 311**	3	1
	MSS 100	3	1	**History 202**	3	1	**Math 356**	3	1	**Astro Engr 310**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	**MSS 400**	3	1
		18.5	10		18.5	9		18.5	8	*Phy Ed*	0.5	2
											19	10

Course Unit Summary
Core (31)
Major (16)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

METEOROLOGY

THE METEOROLOGY MAJOR AT A GLANCE: 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 taken from satellites have given us a truly global weather perspective. Doppler radars enable 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, geography 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 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.

COURSE REQUIREMENTS: 148 Semester Hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternate:*

Required Core Alternate		**Substitutes for**
Geog 310	Geospatial Information Analysis	Systems Option

B. *5 Semester hours of Director of Athletics core courses.*

C. 3 *Semester hours of Academy Option.*

D. *6 Semester hours of Foreign Language.*

E. *43 Semester hours of major's courses*:

1. Math 243 (or Math 253) Calculus III (or Advanced Placed Calculus III)
2. Meteor 320 Introduction to Atmospheric Science
3. Meteor 325 Weather Data, Analysis and Quantitative Methods
4. Meteor 330 Atmospheric Physics
5. Meteor 352 Climatology

6. Meteor 430 Atmospheric Dynamics I
7. Meteor 431 Atmospheric Dynamics II
8. Meteor 440 Synoptic-Dynamic Meteorology Laboratory
9. Meteor 451 Synoptic Meteorology
10. Meteor 452 Mesoscale Meteorology
11. Meteor 465 Marine and Tropical Meteorology
12. Physics 370 Upper Atmospheric and Geo-Space Physics
13. One Meteorology Elective course from the following:
    - Geog 351 Physical Geography
    - Math 245 Differential Equations
    - Meteor 499 Independent Study
    - Physics 315 Combat Aviation Physics
14. Academic Division Option
15. Meteor 405 First-Class Seminar

SUGGESTED COURSE SEQUENCE

Meteorology Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
Fall	**Chem 141**	3	2	Math 243	3	1	Meteor 325	3	1	Meteor 431	3	1
	Comp Sci 110	3	1	**Beh Sci 110**	3	1	Meteor 330	3	1	Meteor 440	3	1
	English 111	3	1	**English 211**	3	1	**Pol Sci 311**	3	1	Meteor 451	3	1
	Math 141	3	1	**Physics 215**	3	2	**El Engr 215**	3	1	***Academy Option***	3	2
	Engr 100	3	1	**Engr Mech 120**	3	1	**Math 300**	3	1	**English 411**	3	1
				Foreign Lang I	3	2	**Law 220**	3	1	**Astro Engr 310**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
		15.5	8		19	10		19	8		18.5	9
Spring	**Soc Sci 112**	3	1	Meteor 320	3	1	Meteor 352	3	1	Meteor 405	0	1
	Chem 142	3	2	**Civ Engr 210**	3	1	Meteor 430	3	1	Meteor 452	4	2
	Math 142	3	1	**Econ 200**	2	1	Physics 370	3	1	Meteor 465	3	1
	History 101	3	1	**Mgt 200**	2	1	**Beh Sci 310**	3	1	Meteor Elective	3	1
	Physics 110	3	2	**Biology 215**	3	2	**Aero Engr 315**	3	1	Open Option	3	1
	MSS 100	3	1	**History 202**	3	1	**Geog 310**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	**Foreign Lang II**	3	2	*Phy Ed*	0.5	2	**Philos 310**	3	1
				Phy Ed	0.5	2		18.5	8	*Phy Ed*	0.5	2
		18.5	10		19.5	11					19.5	10

Course Unit Summary
Core (31)
Major (14)
Academy Option (1)
Foreign Language (2)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	43.0	"
Academy Option=	3.0	"
Foreign Languages=	6.0	"
Phy Ed =	5.0	"
Total =	**148.0**	"

MILITARY STRATEGIC STUDIES

THE MSS MAJOR AT A GLANCE: Your effectiveness as an aerospace leader will be shaped by your ability to innovate and apply military strategy and doctrine to the variety of exciting operational challenges you will face. The Military Strategic Studies program prepares you to operate responsibly and successfully across the spectrum of violence and conflict. Whether you choose to make the Air Force a career, pursue other public service, or enter the private sector, this versatile major will provide you the knowledge and mindset to compete successfully in a demanding environment.

The MSS major is built upon five courses about military power and its uniquely violent context: developing the military strategist, principles and practice of aerospace warfare, space power theory & doctrine, information operations doctrine & strategy, and civil-military relations. This foundation sharpens and deepens the basic knowledge you gain in the Academy core, to include MSS courses in military theory & aerospace power, and joint & coalition operations. You will explore weapons technology and employment in a course modeled after the Air Force Weapons School. Your two courses devoted to contemporary applications of air combat and space warfare are continually updated by concepts identified in USAF battle laboratories such as the Air Warfare Center and Space Warfare Center. In your second-class year you choose a senior thesis topic and design it with a thesis advisor in a research methods course. As a first-class cadet, you complete your aerospace power thesis in a capstone writing course.

In addition to these ten required courses, the MSS major offers two electives, plus the Academy Option, chosen from an array of various academic approaches to understanding military power. You may decide to incorporate a foreign language minor, or concentrate in any of eight areas from aerospace ops planning & execution to space studies. Or you may create your own theme by combining these offerings. Whichever course of study you plan, the MSS major strengthens your decision making and problem-solving skills and directly prepares you to excel in the Air Force mission: to defend the United States and protect its interests through aerospace power.

COURSE REQUIREMENTS: 147 Semester Hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
Ops Rsch 310 or Geog 310	Systems Analysis or Geospatial Information Analysis	Systems Option

B. *5 Semester hours of Director of Athletics courses.*

C. 3 *Semester hours of Academy Option*.

D. *12 Semester hours of Foreign Language.*

E. *36 Semester hours of major's courses:*

30 Semester hours of specified major's courses:

Professional Context, *four courses:*

Philos 311	War, Morality & the Military Profession
MSS 365	Developing the Military Strategist
MSS 463	Military Innovation and Officership
MSS 466	American Civil-Military Relations

Battlespace Awareness, *two courses*

MSS 382	Air and Space Power Theory
MSS 385	Information Operations Strategy

Battlespace Exploitation, choose *two of four courses*

MSS 381	Principles and Practice in Air and Space Warfare
MSS 395	Air Combat Operations
MSS 468	Weapons Technology, Strategy and Employment
MSS 485	Space Operations & the Warfighter

Research Methods (Second-Class Year Paper), *one course*

MSS 379	Research Methods in the Military Strategic Studies

Capstone (First-Class Year Thesis), *one course*

MSS 498	Capstone Thesis in Military Strategic Studies

6 Semester hours of major's elective courses (two courses from the following options)

Aerospace Operations Planning & Execution

MSS 383	Aerospace Strategy & Instructor Qualification
MSS 483	Specialized Applications & Aerospace Strategy *(prereq MSS 383)*

Space Studies

History 376	A History of Space Power
Pol Sci 465	US National Space Policy

Security & Modern Warfare

History 363	Unconventional Warfare
History 371	Airpower & Modern Warfare
History 372	Sea Power and Modern Warfare
Law 495	National Security Law
Pol Sci 396	Politics of US National Security
Pol Sci 421	International Security: Political Violence and Terrorism
Pol Sci 460	Comparative Security Policy and Civil-Military Relations
Pol Sci 496	Seminar in National Security

Foreign Area Specialty

Any Foreign Language courses beyond the four core (200+level)

Any Foreign Area Studies courses

Military Leadership & Resource Management

Beh Sci 410	Advanced Topics in Leadership
Beh Sci 371	Aviation Psychology
Econ 310	Macro Economics
Econ 374	Survey of International Economic Issues
Law 421	Law for Commanders
Mgt 303	Management Perspectives
Mgt 371	Managerial Decision Models
Mgt 391	Management Info Systems
Mgt 472	Strategic Management
Mgt 477	Production and Ops Management
Mgt 485	Systems Acquisition Management
Ops Rsch 310	Systems Analsyis

Military Literature, Thought & Ethics

English 494	Literature of War
History 457	History of Military Thought
Philos 311	War, Morality & the Military Profession

Military Technology & Environment

History 320	History of Technology and Warfare
Meteor 300	Aviation Meteorology
Meteor 320	Introduction to Atmospheric Science

Military Strategic Studies

MSS Option	Any non-core MSS course

SUGGESTED COURSE SEQUENCE

Military Strategic Studies Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
Fall	**Chem 141**	3	2	**Beh Sci 110**	3	1	MSS 382	3	1	MSS 466	3	1
	Engr 100	3	1	**Soc Sci 112**	3	1	MSS 379	3	1	Battle Exploitation Optio	3	1
	MSS 100	3	1	**Physics 110**	3	2	**Phil 310**	3	1	***Academy Option***	3	1
	Math 141	3	1	**Engr Mech 120**	3	1	**Econ 200**	2	1	**MSS 400**	3	1
	Foreign Lang I	3	2	**Civ Engr 210**	3	1	**El Engr 215**	3	1	**Astro Engr 310**	3	1
	Phy Ed	0.5	2	**Foreign Lang III**	3	1	**Mgt 200**	2	1	**English 411**	3	1
				Phy Ed	1	2	**Aero Engr 315**	3	1	*Phy Ed*	0.5	2
							Phy Ed	1	2			
		15.5	9		19	9		20	9		18.5	8
Spring	**Chem 142**	3	2	**English 211**	3	1	MSS 365	3	1	MSS 498	3	1
	Comp Sci 110	3	1	**Physics 215**	3	2	MSS 385	3	1	MSS 463	3	1
	Math 142	3	1	**History 202**	3	1	Philos 311	3	1	MSS Elective	3	1
	History 101	3	1	**Law 220**	3	1	Battle Exploitation Optio	3	1	MSS Elective	3	1
	English 111	3	1	**Biology 215**	3	2	**Math 300**	3	1	**Beh Sci 310**	3	1
	Foreign Lang II	3	2	**Foreign Lang IV**	3	1	**Pol Sci 311**	3	1	**Energy Systems Core**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		18.5	10		18.5	10		18.5	8		18.5	8

Course Unit Summary
Core (31)
Major (12)
Academy Option (1)
Foreign Language (4)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	36.0	"
Academy Option =	3.0	"
Foreign Language=	12.0	"
Phy Ed =	5.0	
Total =	**147.0**	

OPERATIONS RESEARCH MAJOR

THE OPERATIONS RESEARCH MAJOR AT A GLANCE: 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.

OR, as a discipline, arose from the need to determine optimal resource allocation and assist decision makers during the Second World War. Groups of mathematicians, physical scientists, and economists were assembled during the war 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.

The use of mathematics to model real world systems was nothing new; physicists and economists had been doing this 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 were created, such as mathematical programming and queuing theory.

Operation Research, therefore, entails the development and application of quantitative modeling methods to real management and economics problems. This is an exciting field and 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 Operations Research provided above highlights OR's interdisciplinary nature. USAFA has captured the essence of the field by establishing a truly interdisciplinary major. The OR program is jointly administered by the Departments of Management, Mathematical Sciences, Computer Science, and Economics and Geography. In addition to the basic set of OR courses, your required major's courses will include courses from each of the four departments.

COURSE REQUIREMENTS: 147 Semester hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
Ops Rsch 310	Systems Analysis	Systems Option
Math 377	Applied Probability and Statistics	Math 300

B. *5 Semester hours of Director of Athletics courses.*

C. *3 Semester hours of Academy Option.*

D. *No Foreign Language courses required.*

E. *48 Semester hours of major's courses:*

1. Comp Sci 212	Introduction to Programming for Ops Rsch Majors
2. Comp Sci 362	Computer Simulation
3. Comp Sci 364	Information Storage and Retrieval
4. Econ 332	Microeconomic Theory I
5. Econ 333	Microeconomic Theory II
6. Econ 465	Introduction to Econometrics
7. Econ 466	Forecasting and Model Building
8. Math 243 (or Math 253)	Calculus III (or Advanced Placed Calculus III)
9. Math 344	Matrices and Differential Equations
10. Math 378	Advanced Probability and Statistics
11. Ops Rsch 321	Probabilistic Models
12. Ops Rsch 411	Topics in Mathematical Programming
13. Ops Rsch 419	Capstone in Operations Research: Case Studies
14. Ops Rsch 420	Capstone in Operations Research
15. Ops Rsch Option I	(See Supplemental Information)
16. Ops Rsch Option II	(See Supplemental Information)
17. Ops Rsch 405	First-class Seminar

Supplemental Information:

Ops Rsch Options: Select 6.0 semester hours from the courses listed below.

Any 300- or 400-level course offered by the Mathematical Sciences, Management, Computer Science, or Economics departments or any non-core courses required for a major in Mathematics, Management, Computer Science, or Economics not including any course otherwise required for the Operations Research major.

SUGGESTED COURSE SEQUENCE

Operations Research Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Chem 141	3	2	Math 243	3	1	Econ 332	3	1	Econ 465	3	1
	Comp Sci 110	3	1	**Law 220**	3	1	Comp Sci 212	3	2	Ops Rsch 419/405	3	1
Fall	**Engr 100**	3	1	**Econ 200**	2	1	OpsRsch 411	3	1	Ops Rsch Option 1	3	1
	English 111	3	1	**El Engr 215**	3	1	**Math 377**	3	1	***Academy Option***	3	1
	Math 141	3	1	**Engr Mech 120**	3	1	**Beh Sci 310**	3	1	**English 411**	3	1
	Phy Ed	0.5	2	**Physics 215**	3	2	**Aero Engr 315**	3	1	**Astro Engr 310**	3	1
		15.5	8	*Phy Ed*	1	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
					18	9		19	9		18.5	8
				Math 344	3	1						
	Chem 142	3	2	**Ops Rsch 310**	3	1	Econ 333	3	1	Ops Rsch 420	3	1
	History 101	3	1	**Beh Sci 110**	3	1	Ops Rsch 321	3	1	Econ 466	3	1
Spring	**Math 142**	3	1	**Biology 215**	3	2	Comp Sci 362	3	1	Ops Rsch Option 2	3	1
	Physics 110	3	2	**English 211**	3	1	Math 378	3	1	Comp Sci 364	3	1
	MSS 100	3	1	**Mgt 200**	2	1	**History 202**	3	1	**Pol Sci 311**	3	1
	Soc Sci 112	3	1	**Civ Engr 210**	3	1	**Philos 310**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		18.5	10		20.5	10		18.5	8		18.5	8

Course Unit Summary
Core (31)
Major (16)
Academy Options (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy. Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

PHILOSOPHY MINOR

THE PHILOSOPHY MINOR AT A GLANCE: 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 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).

COURSE REQUIREMENTS:

Four courses (12 semester hours) in addition to Philosophy 310 in which the student earns a grade of "C" or better. Required courses include:

1. Philos 390 Great Philosophers
2. One of the following logic courses:
   Philos 360 Applied Reasoning
   Philos 370 Introduction to Symbolic Logic

3/4. Any two philosophy courses not taken above

WHY STUDY PHILOSOPHY? Philosophy is an ancient and valuable subdistrict 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 cadets 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.

PHYSICS

THE PHYSICS MAJOR AT A GLANCE: 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; your vision can help you design a Physics sequence that fits your role as an Air Force officer. The Physics curriculum blends traditional academic instruction, practical laboratory work and independent research projects to develop your ability to think creatively and analytically.

The Physics major has a reputation for being challenging, but its rewards are great. It will prepare you for a successful career in the increasingly technical Air Force, and reward you 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.

COURSE REQUIREMENTS: 147 Semester Hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
Physics 421	Thermal and Statistical Physics	Systems Option
El Engr 231	Electrical Circuits and Systems I	El Engr 215
Math 356	Probability and Statistics for Engineers and Scientists	Math 300

B. *5 Semester hours of Director of Athletics core courses.*

C. 3 *Semester hours of Academy Option.*

D. *No Foreign Language courses required.*

E. *12 Semester hours in Applied Mathematics as follows*:

1. Math 243 (or Math 253) Calculus III (or Advanced Placed Calculus III)
2. Math 245 Differential Equations
3. Math 346 Engineering Mathematics
4. Math 469 Partial Differential Equations

F. *24 Semester hours in Physics:*

1.	Physics 264	Modern Physics (Fall or Spring)
2.	Physics 341	Laboratory Techniques (Fall or Spring)
3.	Physics 355	Classical Mechanics (Fall)
4.	Physics 356	Computational Physics (Spring)
5.	Physics 361	Electromagnetic Theory I (Fall)
6.	Physics 362	Electromagnetic Theory II (Spring)
7.	Physics 442*	Advanced Laboratory (Fall or Spring)
	or Physics 480	Astronomical Techniques (Fall or Spring)
8.	Physics 465	Quantum Mechanics (Fall)
9.	Physics 405	First-Class Seminar (Fall)

* Cadets who elect the Astronomy/Space Physics Option usually take Physics 480. Others take Physics 442.

G. *12 Semester hours in one of the following options*. Most of our Physics majors align themselves with one of the following options:

Astronomy/Space Physics Option:

1.	Physics 371	Astronomy (Fall)
2.	Physics 451	Plasma Physics
3.	Physics 453	Solar Planetary Interactions (Spring) or
	or Physics 486	Astrophysics (Spring)
4.	Physics Option	(See Supplemental Information)

Laser Physics/Optics:

1.	Physics 391	Introduction to Optics and Lasers (Fall)
2.	Physics 482	Laser Physics and Modern Optics (Spring)
3.	Physics 393	Solid State Physics (Fall) or
	or Physics 468	Atomic and Nuclear Physics (Spring)
4.	Physics Option	(See Supplemental Information)

Applied Physics Option

You may also propose a sequence of your own by selecting at least four courses (12 credit hours) from the Department of Physics or other Academy academic departments. It is *your* responsibility to identify a coherent four-course sequence. Normally, at least two of the selected courses must be 300-level or higher and one must be a 400-level course. All applied physics option sequences must be approved by the Department of Physics AIC and the department's Director of Advanced Programs. Some popular sequences, which have been completed in the past, are shown below.

Aircraft Propulsion Design: Aero Engr 241/Aero Engr 341/Aero Engr 361/Aero Engr 466
Atmospheric Physics: Meteor 320/Meteor 330/Meteor 430/Meteor 431
Digital Computer Design: El Engr 281/El Engr 382/El Engr 383/El Engr 484
*Mathematical Physics**: Math 377/Math 451/Math 468/Math 470
Medical Physics (pre-med): Chem 233/Chem 234/Chem 243/Biology 431
Space Vehicle Design: Physics 370/Astro Engr 331/Astro Engr 436/Astro Engr 437

*Students in this sequence should take Math 378 in lieu of Math 356. Math 378 satisfies the Math Core Statistics requirement.

Supplemental Information:

The Physics Option may be any 300-level or higher physics course. In addition to the other courses within the Astronomy/Space Physics Option and the Laser Physics/Optics Option, these include:

Physics 310	Principles of Nuclear Engineering (Spring)
Physics 315	Combat Aviation Physics (Spring)
Physics 370	Upper Atmospheric and Geo-Space Physics (Spring)
Physics 495	Special Topics (Fall/Spring)
Physics 499	Independent Study (Fall/Spring)

You may also take many 300-level or higher courses in the Basic Sciences division or Engineering division as the Physics Option (per approval by the Department of Physics AIC and Director of Advanced Programs). For example:

Astro Engr 331	Space Systems Engineering (Spring)
Math 468	Dynamical Systems (Spring)
Math 470	Mathematical Physics (Spring)
Meteor 320	Introduction to Atmospheric Science (Fall)

SUGGESTED COURSE SEQUENCE

Physics Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Chem 141	3	2	Math 243	3	1	Physics 355	3	1	Physics 442/480	3	2
	History 101	3	1	**Civ Engr 210**	3	1	Physics 361	3	1	Physics 465	3	1
Fall	**English 111**	3	1	**Beh Sci 110**	3	1	Physics Conc 1	3	1	Physics Conc 2	3	1
	Math 141	3	1	**English 211**	3	1	Math 346	3	1	Physics 405	0	1
	Engr 100	3	1	**Physics 215**	3	2	**Econ 200**	2	2	Math 469	3	1
				Soc Sci 112	3	1	**Mgt 200**	2	1	**Beh Sci 310**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	**Pol Sci 311**	3	1	**Physics 421 ***	3	1
							Phy Ed	1	2	*Phy Ed*	0.5	2
		15.5	8		19	9		20	10		18.5	10
	Physics 110	3	2	Physics 264	3	1	Physics 341	3	2	Physics Conc 3	3	1
	Chem 142	3	2	Math 245	3	1	Physics 356	3	1	Physics Conc 4	3	1
Spring	**Math 142**	3	1	**El Engr 231**	3	1	Physics 362	3	1	***Academy Option***	3	1
	Comp Sci 110	3	1	**Biology 215**	3	2	**Law 220**	3	1	**English 411**	3	1
	Engr Mech 120	3	1	**Math 356 ***	3	1	**Philos 310**	3	1	**Astro Engr 310**	3	1
	MSS 100	3	1	**History 202**	3	1	**Aero Engr 315**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
		18.5	10		18.5	9		18.5	9		18.5	8

Course unit summary:
Core (31*)
Major (16**)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy Option =	3.0	"
Phy Ed =	4.5	"
Total =	**146.5**	"

POLITICAL SCIENCE

THE POLITICAL SCIENCE MAJOR AT A GLANCE: 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 cadets 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 cadets to study areas in-depth or to examine a variety of political topics. In addition, cadets who wish to earn a Foreign Language minor may take three of the four required upper-level (200-level or above) 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. Cadets can also work with their advisors to tailor an academic program to meet their individual needs.

COURSE REQUIREMENTS: 147 Semester Hours

A. *91 Semester hours of Dean's academic core courses.*

B. *5 Semester hours of Director of Athletics core courses.*

C. *12 Semester hours of Foreign Language.*

D. *3 Semester hours of Academy Option.*

E. *36 Semester hours of major's courses*:

1. Pol Sci 300 (F) — Introduction to Political Science: Overview and Methods
2. Pol Sci 301 (F) — Political Theory

3.-5. Select three of the following four courses:
- Pol Sci 390 (S) — International Relations Theory (see Note 1)
- Pol Sci 392 (S) — American Political System/Theory
- Pol Sci 394 (S) — Comparative Government and Politics
- Pol Sci 396 (F) — US Foreign and National Security Policy

6. Pol Sci 491 (S) — Capstone Seminar in Political Science (see Note 2)

7.-11. Pol Sci Option — Any Pol Sci course or For Ar Stu 410/420/430/440

12. Soc Sci/Hum Option — Any Soc Sci or Hum course (may be For Lang (see Note 3)

(F) - fall only (S) - spring only

Notes:

1. Two of the three Pol Sci 39X courses must be taken during the 6th semester. If chosen,

Pol Sci 396 should normally be taken the 7th semester.

2. Pol Sci 491 must be taken during the 8th semester.
3. Cadets taking a Foreign Language minor must take twelve semester hours in residence at the 200-level or above in the same language.
4. Cadets desiring to earn a minor in Philosophy may fill one Political Science option with Philos 311, 382, 390, 395, 401, or 402.

Supplemental Information

The major is very flexible; however, the following lists of courses may be helpful to cadets who wish to focus their study of political science into one of four specific options. Cadets need not be confined to these four areas, but should discuss the appropriate choices with their academic advisors to tailor an academic program to meet their individual needs. For example, one could construct a concentration in political economy by selecting the appropriate courses listed in this handbook. In this way, cadets may design their own "areas of concentration." Please note that only political science courses count for Political Science Options. The non-political science courses listed below are suggestions to fill non-political science electives.

AMERICAN POLITICS

Pol Sci 396	US Foreign and National Security Policy
Pol Sci 451	American Political Thought
Pol Sci 462	Politics and Intelligence
Pol Sci 465	U.S. National Space Policy
Pol Sci 481	American Elections and Political Parties
Pol Sci 482	Politics of the Judiciary and the Supreme Court
Pol Sci 483	The U.S. Congress
Pol Sci 484	The American Presidency
Pol Sci 485	Decision Making in Public Policy
Pol Sci 496	The Politics of National Security Policy
Mgt 445	Organizational Theory
Econ 356	Macroeconomic Theory
Econ 473	Public Finance
History 335	History of the American West
History 336	History of the American South
History 338	Crises in American History
History 351	The Foundations of Modern America
History 352	The History of Modern America
History 480	Studies in American Civilization
History 483	Great Americans
Law 351	U.S. Constitutional Law

COMPARATIVE AND AREA STUDIES

Pol Sci 421	International Security: Political Violence and Terrorism
Pol Sci 444	International Political Economy
Pol Sci 460	Comparative Security Policy and Civil-Military Relations
Pol Sci 462	Politics and Intelligence

Pol Sci 469	Politics of Russia and Newly Independent States
Pol Sci 471	Politics of Europe
Pol Sci 473	Politics of Asia
Pol Sci 475	Politics of Latin America
Pol Sci 477	Politics of the Middle East
Pol Sci 479	Politics of Sub-Saharan Africa
Econ 351	Comparative Economic Systems
Econ 374	Survey of International Economic Issues
Econ 454	Economics of Transition and Development
Econ 457	The Economy of China
Hum 461	Russian Literature
Hum 463	Far Eastern Literature
Philos 401	Comparative Religion
Philos 402	Philosophy of Religion
Law 330	Comparative Legal Systems

For Lang Electives, Area History Electives, Area Geog Electives, ForAStu Electives

INTERNATIONAL RELATIONS

Pol Sci 396	US Foreign and National Security Policy
Pol Sci 421	International Security: Political Violence and Terrorism
Pol Sci 423	War Crimes, Genocide, and Human Rights
Pol Sci 444	International Political Economy
Pol Sci 445	International Organizations and Global Issues
Pol Sci 460	Comparative Security Policy and Civil-Military Relations
Pol Sci 462	Politics and Intelligence
Pol Sci 465	U.S. National Space Policy
Pol Sci 469	Politics of Russia and Newly Independent States
Pol Sci 471	Politics of Europe
Pol Sci 473	Politics of Asia
Pol Sci 475	Politics of Latin America
Pol Sci 477	Politics of the Middle East
Pol Sci 479	Politics of Sub-Saharan Africa
Pol Sci 496	The Politics of National Security Policy
Econ 374	Survey of International Economic Issues
Geog 370	Military Geography
History 332	History of U.S. Foreign Policy
Law 461	International Law
Law 470	Air and Space Law
Philos 401	Comparative Religion
Philos 402	Philosophy of Religion

NATIONAL SECURITY POLICY

Pol Sci 396	US Foreign and National Security Policy
Pol Sci 421	International Security: Political Violence and Terrorism
Pol Sci 440	Contemporary Issues in International Security
Pol Sci 444	International Political Economy

Pol Sci 460	Comparative Security Policy and Civil-Military Relations
Pol Sci 462	Politics and Intelligence
Pol Sci 465	U.S. National Space Policy
Pol Sci 483	The U.S. Congress
Pol Sci 484	The American Presidency
Pol Sci 485	Contemporary Issues in American Politics
Pol Sci 496	The Politics of National Security Policy
Law 462	Government Acquisition Law
Law 470	Air and Space Law
Econ 478	Seminar in Defense Economics
History 320	History of Technology and Warfare
History 363	Unconventional Warfare
History 368	World War II
History 369	History of the Vietnam War
History 371	Airpower and Modern Warfare
History 376	A History of Space Power
History 394	The American Civil War
History 457	History of Military Thought
Mgt 346	Organizational Theory

SUGGESTED COURSE SEQUENCE

Political Science Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
Fall	Chem 141	3	2	Pol Sci 311	3	1	Pol Sci 300	3	1	Pol Sci Option	3	1
	Comp Sci 110	3	1	Physics 110	3	2	Pol Sci 301	3	1	Pol Sci Option	3	1
	English 111	3	1	Beh Sci 110	3	1	Pol Sci 39X	3	1	Soc Sci/Hum Option	3	1
	Math 141	3	1	History 202	3	1	El Engr 215	3	1	Beh Sci 310	3	1
	Foreign Lang I	3	2	Engr 100	3	1	Biology 215	3	2	Astro Engr 310	3	1
				Foreign Lang III	3	1	Civ Engr 210	3	1	Geog 340	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
		15.5	9		19	9		19	9		18.5	8
Spring	Chem 142	3	2	Law 220	3	1	Pol Sci 39X	3	2	Pol Sci 491	3	1
	Math 142	3	1	English 211	3	1	Pol Sci 39X	3	1	Pol Sci Option	3	1
	Soc Sci 112	3	1	Physics 215	3	2	Pol Sci Option	3	1	Pol Sci Option	3	1
	History 101	3	1	Mgt 200	2	1	Philos 310	3	1	*Academy Option*	3	1
	MSS 100	3	1	Econ 200	2	1	Math 300	3	1	Aero Engr 315	3	1
	Foreign Lang II	3	2	Engr Mech 120	3	1	English 411	3	1	MSS 400	3	1
	Phy Ed	0.5	2	Foreign Lang IV	3	1	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2
				Phy Ed	0.5	2						
		18.5	10		19.5	10		18.5	9		18.5	8

Course unit summary:
Core (31)
Major (12)
Foreign Language (4)
Academy Option (1)
Phy Ed (10)

Semester hour summary:		
Core =	91.0	Sem Hours
Major =	36.0	"
Foreign Language =	12.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	147.0	"

SPACE OPERATIONS

THE SPACE OPERATIONS MAJOR AT A GLANCE: The Space Operations major is an interdisciplinary program with primary emphasis on preparing cadets 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, geography, 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 also provides the student with excellent preparation for entering a graduate program in Space Operations.

Space operations are the backbone of Air Force Space Command and are vital to our nation's warfighting capabilities. This program gives you the chance to directly apply what you learn in your major to an Air Force career. The Space Operations major will give you a solid framework for your 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. Finally, the Space Operations major concludes with a capstone operations experience where you will command and control one of the FalconSAT cadet-built satellites.

Some Air Force Specialties open to space operations majors include: satellite command and control, space lift, space warning, missile combat crew, space and missile maintenance, air battle management, communications, and acquisitions.

COURSE REQUIREMENTS: 147 Semester Hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
Geog 310	Geospatial Information Analysis	Systems Option
Math 356	Probability and Statistics for Engineers and Scientists	Math 300

B. *5 Semester hours of Director of Athletics core courses.*

C. *3 Semester hours of Academy Option.*

D. *6 Semester hours of Foreign Language in a strategic area.*

E. *42 Semester hours of major's courses*:

1. Astro Engr 331 (F/S) — Space Systems Engineering
2. Geog 382 (S) — Remote Sensing and Imagery Analysis
3. OpsRsch 310 (F/S) — Systems Analysis

4. Mgt 485 (S even yrs) Systems Acquisition Management
5. MSS 382 (F) Air and Space Power Theory
6. MSS 485 (F) Space Operations and the Warfighter
7. Pol Sci 465 (F) US National Space Policy and Law
8. Physics 370 (S) Upper Atmospheric and Geo-Space Physics
9. History 376 (S even yrs) A History of Space Power
10. Space Ops 360 (S) Basic Space Operations
11. Space Ops 461 Intermediate Space Operations
12. Space Ops 462 Master of Space Operations
13. Nuclear, Biological, and Chemical Option (See Supplemental Information 1)
14. Space Science Option (See Supplemental Information 2)

Supplemental Information:

(F/S)-Offered both Fall and Spring (F)-Fall only (S)-Spring only

1. Nuclear, Biological, and Chemical (NBC) Option

Chem 350 (F/S)	Chemistry of Weapons
Physics 310 (S)	Principles of Nuclear Engineering

2. Space Science Option

Physics 371 (F)	Astronomy
Biology 350 (S)	Space Biology and Exploration
Chem 325 (F)	Space Chemistry

Any 300- or 400-level course, with AIC approval, offered by the Department of Astronautics not already used to fulfill another major's requirement. Must have AIC approval.

SUGGESTED COURSE SEQUENCE

Space Operations Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Math 141	3	1	OpsRsch 310	3	1	Astro Engr 331	3	1	MSS 385	3	1
	Chem 141	3	2	**Astro Engr 310**	3	1	MSS 382	3	1	Space Ops 461	3	1
Fall	**History 101**	3	1	**Engr Mech 120**	3	1	**Pol Sci 311**	3	1	Pol Sci 465	3	1
	English 111	3	1	**El Engr 215**	3	1	**Biology 215**	3	2	Space Science Option	3	1
	Beh Sci 110	3	1	**Physics 215**	3	2	**Geog 310**	3	1	**Beh Sci 310**	3	1
				Foreign Lang I	3	2	**Law 220**	3	1	**MSS 400**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	*Phy Ed*	1	2	*Phy Ed*	0.5	2
		15.5	8		19	10		19	9		18.5	8
	Math 142	3	1	NBC Option	3	1	Space Ops 360	3	2	Space Ops 462	3	1
	Comp Sci 110	3	1	Physics 370	3	1	Geog 382	3	1	Mgt 485	3	1
Spring	**Engr 100**	3	1	**Soc Sci 112**	3	1	**Philos 310**	3	1	History 376	3	1
	Physics 110	3	2	**History 202**	3	1	**Aero Engr 315**	3	1	***Academy Option***	3	1
	Chem 142	3	2	**English 211**	3	1	**Econ 200**	2	1	**Math 356**	3	1
	MSS 100	3	1	**Foreign Lang II**	3	2	**Mgt 200**	2	1	**English 411**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	**Civ Engr 210**	3	1	*Phy Ed*	0.5	2
							Phy Ed	0.5	2		18.5	8
		18.5	10		18.5	9		19.5	10			

Course Unit Summary
Core (31)
Major (14)
Foreign Language (2)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	42.0	"
Foreign Language =	6.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	147.0	"

SYSTEMS ENGINEERING

THE SYSTEMS ENGINEERING MAJOR AT A GLANCE: Systems Engineering is an interdisciplinary major administered by the Departments of Aeronautical Engineering, Astronautical Engineering, Behavioral Sciences and Leadership, Computer Science, Electrical Engineering, and Engineering Mechanics with participation by the Department of Management.

Systems Engineering is a broad discipline that addresses the engineering of large, complex systems and the integration of the many subsystems that comprise the larger system. All of these various components must function together in an effective and efficient manner in order to carry out the mission. The systems engineer designs, integrates, and helps to ensure smooth functioning of complex systems typical in today's high-tech Air Force. The systems engineer is a "big picture" engineer, always keeping an eye on the design of the overall system to ensure that it will meet the needs of all the system's stakeholders, including operators, maintainers and commanders, and even our ultimate customer -- the American public!

The systems engineer must 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 system's development cycle. To accomplish this difficult job, the SE must have broad interdisciplinary knowledge across many areas of study.

USAFA's system engineering program emphasizes a systems-of-systems approach that integrates a rigorous engineering curriculum augmented with studies in human systems, operations research analysis, program management, and the core curriculum. Cadets will learn that the systems engineering process is an interdisciplinary engineering process that evolves, verifies, and documents an integrated, life-cycle-balanced set of system solutions that satisfy customer needs. Cadets will specialize in one of nine defined option areas which include: Aeronautical Systems, Communication Systems, Computer Systems, Control Systems, Electronic Systems Design, Human Systems, Information Systems, Mechanical Systems, and Space Systems.

Cadets who successfully complete the Systems Engineering major are awarded a Bachelor of Science in Systems Engineering degree.

Systems Engineering *Program Operational Goals*

Two to three years after graduation, our graduates are expected to be officers who:

- Possess breadth of integrated, fundamental knowledge in the basic sciences, engineering, 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, and

- Know and practice their ethical and professional responsibilities as embodied in the United States Air Force core values.

Systems Engineering *Program Curricular Outcomes*

Each Systems Engineering graduate shall demonstrate satisfactory:

- Application of the fundamental concepts of systems engineering to solve 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 about engineering design in the chosen area of emphasis,
- Synthesis and integration of the above knowledge to effectively identify and solve the types of complex, multidisciplinary problems encountered as Air Force systems engineers,
- 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 officers in our global society, and
- Knowledge of contemporary social, political, military, and engineering issues.

COURSE REQUIREMENTS: 147 semester hours

A. 91 Semester hours of Dean's academic core coursesto include the following core alternates:

Required Core Alternate		**Substitutes for**
Ops Rsch 310	Systems Analysis	Systems Option
El Engr 231	Electrical Circuits and Systems I	El Engr 215
Math 356	Probability and Statistics for Engineers and Scientists	Math 300

B. *5 Semester hours of Director of Athletics courses.*

C. *3 Semester hours of Academy Option.*

D. *No Foreign Language courses required.*

E. *21 Semester hours of major's courses:*

1. Sys Engr 290 Introduction to Systems Engineering I
2. Sys Engr 301 Introduction to Systems Engineering II

3. Ops Rsch 321 — Probabilistic Models
   or Ops Rsch 411 — Topics in Mathematical Programming
4. Comp Sci 211 — Intro to Programming for Scientists and Engineers
5. Beh Sci 373 — Introduction to Human Factors
6. Systems Engineering Capstone Design I (See Supplemental Information)
7. Systems Engineering Capstone Design II (See Supplemental Information)
8. Sys Engr 405 — Systems Engineering Seminar I
9. Sys Engr 406 — Systems Engineering Seminar II

F. *27 Semester hours of courses determined by the cadet's choice of systems engineering option sequence:*

Aeronautical Systems Option:

Math 243 (or Math 253)	Calculus III (or Advanced Placed Calculus III)
Math 245	Differential Equations
Engr Mech 320	Dynamics
Aero Engr 241	Aero-Thermodynamics
Aero Engr 341	Aeronautical Fluid Dynamics
Aero Engr 351	Aircraft Performance and Static Stability
Aero Engr 352	Aircraft Dynamic Stability and Control
Aero Engr 361	Propulsion
Sys Engr Option	Any 300 or 400 level Engineering, Operations Research, or Basic Science course where the prerequisites are met

Communication Systems Option:

Math 243 (or Math 253)	Calculus III (or Advanced Placed Calculus III)
Math 245	Differential Equations
El Engr 332	Electric Circuits and Systems II
El Engr 333	Continuous-Time Signals and Linear Systems
El Engr 434	Discrete-Time Signals and Systems
El Engr 447	Communications Systems I
El Engr 448	Communications Systems II
Sys Engr Option I	Astro Engr 331, Engr 341, or any non-core course offered by the Electrical Engineering Department,
Sys Engr Option II	Any 300 or 400 level Engineering, Operations Research, or Basic Science course where the prerequisites are met

Computer Systems Option:

Math 340	Discrete Math
Math Option	Math 243 (or Math 253), Math 245, Philos 370, or Comp Sci 431 (Cryptography)
Comp Sci 362	Modeling and Simulation
Comp Sci 364	Information Storage and Retrieval
Comp Sci 467	Networks
El Engr 281	Introductory Digital Systems
El Engr 382	Microcomputer Programming

El Engr 383	Microcomputer System Design I
Sys Engr Option	Any 300 or 400 level Engineering, Operations Research, or Basic Science course where the prerequisites are met

Control Systems Option:

Math 243 (or Math 253)	Calculus III (or Advanced Placed Calculus III)
Math 245	Differential Equations
Engr Mech 320	Dynamics
Engr 341	Linear Systems Analysis
Engr 342	Linear Control Systems
Astro Engr 443	Digital Control
Astro Engr 444	Modern Control
Sys Engr Option I	Any 300 or 400 level Engineering, Operations Research, or Basic Science course where the prerequisites are met
Sys Engr Option II	Any 300 or 400 level Engineering, Operations Research, or Basic Science course where the prerequisites are met

Electronic Systems Design Option:

Math 243 (or Math 253)	Calculus III (or Advanced Placed Calculus III)
Math 245	Differential Equations
El Engr 321	Electronics I
El Engr 322	Electronics II
or Comp Engr 373	Digital VLSI Circuits
El Engr 332	Elecric Circuits and Systems II
El Engr 281	Introductory Digital Systems
El Engr 382	Microcomputer Programming
El Engr 383	Microcomputer Systems Design I
Sys Engr Option	Any 300 or 400 level Engineering, Operations Research, or Basic Sciences course where the prerequisites are met

Human Systems Option:

Math 245	Differential Equations
Math Option	Math 243 (or Math 253) or Math 340
Beh Sci 375	Human Factors in Systems Failure
Beh Sci 471	Engineering Psychology
Beh Sci 472	Human Computer Interaction
Beh Sci 473	Human Factors in Systems Design
Sys Engr 472	Cognitive Systems Engineering
Sys Engr Option I	Any 300 or 400 level Engineering, Operations Research, or Basic Science course where the prerequisites are met
Sys Engr Option II	Any Option I course or 300 or 400 level AIC approved course in Behavioral Sciences, Operations Research, or Management.

Information Systems Option:

Math 340	Discrete Math

Math Option	Math 243 (or Math 253), Math 245, Philos 370, or Comp Sci 437 (Cryptography)
Comp Sci 310	Information Technology
Comp Sci 315	Web Design and Construction
Comp Sci 362	Modeling and Simulation
Comp Sci 364	Information Storage and Retrieval
Comp Sci 438	Computer Security and Information Warfare
Comp Sci 467	Networks (need to waive prereq, CS 483)
Sys Engr Option	Any 300 or 400 level Engineering, Operations Research, or Basic Science course where the prerequisites are met

Mechanical Systems Option:

Math 243 (or Math 253)	Calculus III (or Advanced Placed Calculus III)
Math 245	Differential Equations
Engr Mech 320	Dynamics
Mech Engr 312	Thermal Fluids Engineering I
Engr Mech 330	Mechanics of Deformable Bodies
Mech Engr 325	Engineering System Dynamics
Engr Mech 350	Mechanical Behavior of Materials
Sys Engr Option I	Any 300 or 400 level Engineering or Basic Science course where the prerequisites are met
Sys Engr Option II	Any 300 or 400 level Engineering, Operations Research, or Basic Science course where the prerequisites are met

Space Systems Option:

Math 243 (or Math 253)	Calculus III (or Advanced Placed Calculus III)
Math 245	Differential Equations
Engr Mech 320	Dynamics
Aero Engr 241	Aero-Thermodynamics
Astro Engr 321	Astrodynamics
Astro Engr 331	Space Systems Engineering
Astro Engr 351	Rocket Propulsion
Astro Engr 423	Space Mission Design
Sys Engr Option	Any 300 or 400 level Engineering, Operations Research, or Basic Science course where the prerequisites are met

Supplemental Information:

Cadets will be placed into one of the following two-semester capstone design options, based on interest, performance, and availability, to satisfy the Systems Engineering Capstone Design sequence requirement.

Aeronautical Engineering Capstone Design A

Aero Engr 481	Intro to Aircraft and Propulsion System Design
Aero Engr 482	Aircraft Design

Aeronautical Engineering Capstone Design B

Aero Engr 481	Intro to Aircraft and Propulsion System Design

Aero Engr 483	Aircraft Engine Design

Astronautical Engineering Capstone Design A

Astro Engr 436	Small Spacecraft Engineering I
Astro Engr 437	Small Spacecraft Engineering II

Astronautical Engineering Capstone Design B

Astro Engr 452	Rocket Engineering I
Astro Engr 453	Rocket Engineering II

Computer Engineering Capstone Design

Comp Engr 463	Capstone Design Project I
Comp Engr 464	Capstone Design Project II

Engineering Mechanics Capstone Design

Mech Engr 491	First-Class Capstone Design Project I
Mech Engr 492	First-Class Capstone Design Project II

Electrical Engineering Capstone Design

El Engr 463	Capstone Design Project I
El Engr 464	Capstone Design Project II

Software Engineering Capstone Design

Comp Sci 453	Software Engineering I
Comp Sci 454	Software Engineering II

SUGGESTED COURSE SEQUENCE

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
Fall	**Chem 141**	3	2	Math Option 243/340	3	1	Comp Sci 211	3	1	Sys Engr Option	3	1
	Comp Sci 110	3	1	**El Engr 231**	3	1	Sys Engr Option	3	1	Sys Engr Option	3	1
	English 111	3	1	**Beh Sci 110**	3	1	**History 202**	3	1	Sys Engr 491	3	2
	Math 141	3	1	**English 211**	3	1	**Ops Rsch 310**	3	1	Sys Engr 405	0	1
	Engr 100	3	1	**Physics 215**	3	2	**Mgt 200**	2	1	**Beh Sci 310**	3	1
				Soc Sci 112	3	1	**Econ 200**	2	1	**English 411**	3	1
	Phy Ed	0.5	2	*Phy Ed*	1	2	**Biology 215**	3	2	**Philos 310**	3	1
							Phy Ed	1	2	*Phy Ed*	0.5	2
		15.5	8		19	9		20	10		18.5	10
Spring	**Physics 110**	3	2	Sys Engr 290	3	2	Ops Rsch 321/411	3	1	Sys Engr Option	3	1
	Chem 142	3	2	Math 245	3	1	Beh Sci 373	3	1	Sys Engr Option	3	1
	Math 142	3	1	Sys Engr Option	3	1	Sys Engr 301	3	1	Sys Engr 492	3	2
	MSS 100	3	1	**Civ Engr 210**	3	1	Sys Engr Option	3	1	Sys Engr 406	0	1
	Engr Mech 120	3	1	**Aero Engr 315**	3	1	**Pol Sci 311**	3	1	***Academy Option***	3	1
	History 101	3	1	**Math 356**	3	1	**Law 220**	3	1	**Astro Engr 310**	3	1
	Phy Ed	0.5	2	*Phy Ed*	0.5	2	*Phy Ed*	0.5	2	**MSS 400**	3	1
		18.5	10		18.5	9		18.5	8	*Phy Ed*	0.5	2
											18.5	10

Course Unit Summary
Core (31)
Major (16)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

SYSTEMS ENGINEERING MANAGEMENT

THE SYSTEMS ENGINEERING MANAGEMENT MAJOR AT A GLANCE: Systems Engineering Management is an interdisciplinary major administered by the Department of Management with participation by the Departments of Aeronautical Engineering, Astronautical Engineering, Behavioral Sciences and Leadership, Computer Science, Electrical Engineering, and Engineering Mechanics.

Systems Engineering Management is a broad discipline that addresses the engineering management of large, complex systems and the integration of the many subsystems that comprise the larger system. All of these various components must function together in an effective and efficient manner in order to carry out the mission. The system engineering manager manages the design, integration, and ensures smooth functioning of complex systems typical in today's high-tech Air Force. The systems engineering manager is focused on the "big picture", always keeping an eye on the design of the overall system to ensure that it will meet the needs of all the system's stakeholders, including operators, maintainers, commanders, and even our ultimate customer -- the American public!

The systems engineering manager must 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 system's development cycle. To accomplish this difficult job, the systems engineering manager must have broad interdisciplinary knowledge across many areas of study.

USAFA's system engineering management program emphasizes a systems-of-systems approach that integrates a rigorous engineering and management curriculum augmented with studies in human systems, operations research analysis, program management, and the core curriculum. Cadets will learn that the systems engineering process is an interdisciplinary engineering process that evolves, verifies, and documents an integrated, life-cycle-balanced set of system solutions that satisfy customer needs.

Cadets who successfully complete the Systems Engineering Management major are awarded a Bachelor of Science in Systems Engineering Management degree.

Systems Engineering Management *Program Operational Goals*

Two to three years after graduation, our graduates are expected to be officers 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, and

- Know and practice their ethical and professional responsibilities as embodied in the United States Air Force core values.

Systems Engineering Management *Program Curricular Outcomes*

Each Systems Engineering Management 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, and
- Knowledge of contemporary social, political, military, and engineering issues.

COURSE REQUIREMENTS: 147 Semester Hours

A. *91 Semester hours of Dean's academic core courses to include the following core alternates:*

Required Core Alternate		**Substitutes for**
Ops Rsch 310	Systems Analysis	Systems Option
Math 356	Probability and Statistics for Engineers and Scientists	Math 300
El Engr 231 or El Engr 215	Electrical Circuits and Systems I, or Electrical Signals & Systems	El Engr 215

B. *5 Semester hours of Director of Athletics courses.*

C. *3 Semester hours of Academy Option.*

D. *No Foreign Language courses required.*

E. *18 Semester hours of systems engineering major's courses:*

1. Sys Engr 290 Introduction to Systems Engineering I

2. Sys Engr 301 Introduction to Systems Engineering II
3. Ops Rsch 321 Probabilistic Models
   or Ops Rsch 411 Topics in Mathematical Programming
4. Beh Sci 373 Introduction to Human Factors
5. Systems Engineering Mgt Capstone Design I (See Supplemental Information #1)
6. Systems Engineering Mgt Capstone Design II (See Supplemental Information #1)
7. Sys Engr 405 Systems Engineering Seminar I
8. Sys Engr 406 Systems Engineering Seminar II

F. *30 Semester hours systems engineering management major's courses:*

1. Math 243 (or Math 253) Calculus III (or Advanced Placed Calculus III)
2. Math 359 Design of Experiments
3. Systems Focus Option (select one)
   j. Mech Engr 312 Thermal Fluids Systems Engineering I
   a. Aero Engr 241 Aero-Thermodynamics
   g. Math 245 Differential Equations
   e. Engr 311 Electrical Power Systems
   c. Comp Sci 211 Introduction to Programming for Scientists and Engineers
   b. Comp Sci 210 Introduction to Programming
   f. Geog 310 Geospatial Information Analysis
   d. Comp Sci 310 Information Technology
   i. Mgt 391 Management Information Systems
   h. Math 344 Matrices and Differential Equations
4. Mgt 303 Management Perspectives
5. Mgt 345 Human Managerial Systems I
6. Mgt 342 Managerial Accounting
7. Mgt 477 Production and Operation Management
8. Mgt 437 Managerial Finance
9. Systems Engineering Mgt Option I (See Supplemental Information #2)
10. Systems Engineering Mgt Option II (See Supplemental Information #2)

Supplemental Information:

1. Cadets will be placed into one of the following two-semester capstone design options, based on interest, performance, and availability, to satisfy the Systems Engineering Management Capstone Design sequence requirement.

Aeronautical Engineering Capstone Design A

Aero Engr 481 Intro to Aircraft and Propulsion System Design
Aero Engr 482 Aircraft Design

Aeronautical Engineering Capstone Design B

Aero Engr 481 Intro to Aircraft and Propulsion System Design
Aero Engr 483 Aircraft Engine Design

Astronautical Engineering Capstone Design A

Astro Engr 436 Small Spacecraft Engineering I
Astro Engr 437 Small Spacecraft Engineering II

Astronautical Engineering Capstone Design B

Astro Engr 452	Rocket Engineering I
Astro Engr 453	Rocket Engineering II

Civil Engineering Capstone Design

Civ Engr 485	Construction Project Management
Civ Engr 480	Project Management and Contract Administration

Computer Engineering Capstone Design

Comp Engr 463	Capstone Design Project I
Comp Engr 464	Capstone Design Project II

Electrical Engineering Capstone Design

El Engr 463	Capstone Design Project I
El Engr 464	Capstone Design Project II

Engineering Mechanics Capstone Design

Mech Engr 491	First-Class Capstone Design Project I
Mech Engr 492	First-Class Capstone Design Project II

Operations Research Capstone Design

Ops Rsch 419	Capstone in Operations Research: Case Studies
Ops Rsch 420	Capstone in Operations Research

Software Engineering Capstone Design

Comp Sci 453	Software Engineering I
Comp Sci 454	Software Engineering II

2. Any AIC approved 300 or 400 level Engineering, Basic Science, Operations Research, or Social Science course where the prerequisites are met.

SUGGESTED COURSE SEQUENCE

Systems Engineering Management Major

	4°	hrs	per	3°	hrs	per	2°	hrs	per	1°	hrs	per
	Chem 141	3	2	Math 243	3	1	Mgt 303	3	2	Mgt 477	3	1
	Comp Sci 110	3	1	**Mgt 200**	2	1	Mgt 345	3	1	Mgt 437	3	1
Fall	**English 111**	3	1	**Econ 200**	2	1	**Aero Engr 315**	3	1	Sys Engr 491	3	2
	Math 141	3	1	**Ops Rsch 310**	3	1	**Law 220**	3	1	SEM Option II	3	1
	Engr 100	3	1	**Beh Sci 110**	3	1	**El Engr 215/231**	3	1	Sys Engr 405	0	1
				Physics 110	3	2	**Biology 215**	3	2	**Philos 310**	3	1
	Phy Ed	0.5	2	**History 202**	3	1	*Phy Ed*	1	2	**Astro Engr 310**	3	1
				Phy Ed	1	2				*Phy Ed*	0.5	2
		15.5	8		20	10		19	10		18.5	10
	Chem 142	3	2	Sys Engr 290	3	1	Sys Engr 301	3	1	Sys Engr 492	3	2
	Math 142	3	1	Systems Focus Option	3	1	Ops Rsch 321/411	3	1	Sys Engr 406	0	1
Spring	**Soc Sci 112**	3	1	**Math 356**	3	1	Mgt 342	3	1	***Academy Option***	3	1
	MSS 100	3	1	**Civ Engr 210**	3	1	Beh Sci 373	3	1	**Beh Sci 310**	3	1
	History 101	3	1	**English 211**	3	1	Math 359	3	1	**Pol Sci 311**	3	1
	Engr Mech 120	3	1	**Physics 215**	3	2	SEM Option I	3	1	**English 411**	3	1
	Phy Ed	0.5	2				*Phy Ed*	0.5	2	**MSS 400**	3	1
				Phy Ed	0.5	2				*Phy Ed*	0.5	2
		18.5	9		18.5	9		18.5	8		18.5	10

Course Unit Summary
Core (31)
Major (16)
Academy Option (1)
Phy Ed (10)

Semester Hour Summary		
Core =	**91.0**	Sem Hours
Major =	48.0	"
Academy Option =	3.0	"
Phy Ed =	5.0	"
Total =	**147.0**	"

SECTION III

CHAPTER 11

COURSE DESCRIPTIONS

Descriptions of courses offered are listed here by subject in alphabetical order. Course numbers have a general meaning. The first digit of a course number normally indicates the class year for which the course is designed: 100 series for the fourth-class year, 200 series for the third-class year, 300 series for the second-class year, and 400 series for the first-class year.

Following the title of each course is a code, such as 3(2). The number before the parentheses is the semester-hour value, used to determine a cadet's semester course load and minimum graduation requirements. A "0" before the parentheses means the course has no semester-hour value. The number within the parentheses is a code indicating the contact hours and scheduling pattern for the course as follows:

CONTACT HOURS AND SCHEDULING PATTERN CODES

CONTACT HOURS	SCHEDULING PATTERN
0	Course not scheduled by DFRR; cadet, instructors, and department make individual arrangements
1	One 50-minute period per lesson (every other day)
1x	One 50-minute period per lesson (every other day) for part of a semester
2	One 110-minute period per lesson (every other day)
2'	Two 50-minute periods per lesson (one every day)
2x	Two 50-minute periods per lesson (one every day) for part of a semester
2"	One 110-minute period each odd lesson, each even lesson, or once per week
2xx	One 110-minute period per lesson (every other day) for part of a semester
3	One 170-minute period per lesson (every other day)
3	One 50-minute period and one 110-minute period per lesson (on successive days)

A "*" designation on the right side of the parentheses means an honors version of the course is

offered. Not all honors versions are offered both fall and spring semesters. Final examination or final report requirements, course prerequisites, semester hours and offering times are shown at the end of each course description. A number of academic courses are offered in both the fall and spring semesters.

NOTE: Double-period academic core courses may utilize the second hour of a lesson a maximum of 10 times per semester. Exemptions may be granted only by the Curriculum Committee. DFF has a temporary exemption for core foreign language courses.

AERONAUTICS (Aero Engr)
Offered by the Department of Aeronautics (DFAN)

Aero Engr 241. Aero-Thermodynamics. 3(1). 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. Final exam. Prereq: Physics 110. Sem hrs: 3 spring.

Aero Engr 315. Fundamentals of Aeronautics. 3(1). Introduction to fluid mechanics, airfoil and wing aerodynamics, steady and accelerated aircraft performance, and stability and control. Interdisciplinary analysis (to include economic, political, and other non-technical factors) of a contemporary aircraft design. Final exam. Prereq: Comp Sci 110 and Engr Mech 120. Sem hrs: 3 fall or spring.

Aero Engr 315Z. Fundamentals of Aeronautics – French language section. 3(1). Section taught in French; available for students qualified for Aero Engr 315 and having successfully completed or validated French 223; counts as a course for the French Language Minor and for a major's foreign language requirement. Requires DFF approval. Final exam. Prereq: Comp Sci 110 and Engr Mech 120. Sem hrs: 3 fall or spring.

Aero Engr 341. Aeronautical Fluid Dynamics. 3(1). 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. Final exam. Prereq: Aero Engr 241. Coreq: Math 346. Sem hrs: 3 fall.

Aero Engr 342. Computational Aerodynamics. 3(2). 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. Final project or final exam. Prereq: Aero Engr 341 and Math 346. Sem hrs: 3 spring.

Aero Engr 351. Aircraft Performance and Static Stability. 3(1). 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. Design project. Final exam. Prereq: Aero Engr 315 and Math 245. Sem hrs: 3 fall.

Aero Engr 352. Aircraft Dynamic Stability and Control. 3(1). 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. Control system design project. Final exam. Prereq: Aero Engr 351 and Engr Mech 320. Sem hrs: 3 spring.

Aero Engr 361. Propulsion I. 3(1). 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. Lab. Design project. Final exam. Prereq: Aero Engr 241 or department permission. Sem hrs: 3 spring.

Aero Engr 436. Aeroelasticity. 3(1). Aeroelastic phenomena of an aircraft in flight. Dyamic 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. Design project and/or final exam. Prereq: Aero Engr 315 and Engr Mech 330. Coreq: Engr Mech 320. Sem hrs: 3 spring.

Aero Engr 442. Aerodynamics. 3(1). 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. Final exam. Prereq: Aero Engr 342. Sem hrs: 3 fall.

Aero Engr 446. Introduction to Hypersonics. 3(1). Analysis of heat transfer and high temperature effects on hypersonic vehicles. Application to reentry and transatmospheric vehicles. Final exam. Prereq: Aero Engr 341. Sem hrs: 3 fall or spring.

Aero Engr 447. Advanced Applied Aerodynamics. 3(1). Advanced topics in steady and unsteady aerodynamics in all speed ranges are considered for study by analytical, experimental and computational methods. Final exam or final project. Coreq: Aero Engr 442. Sem hrs: 3 fall or spring.

Aero Engr 456. Flight Test Techniques. 3(2). Fundamental flight test methods for defining performance and flying qualities characteristics of fixed wing aircraft. Patterned after the Flight Test Engineer's Course at the USAF Test Pilot School. Students fly in designated aircraft to obtain flight test data. Final project or final exam. Prereq: Aero Engr 351 and department permission. Sem hrs: 3 fall or spring.

Aero Engr 456L. Flight Test Techniques Laboratory. 1(2). Application of fundamental flight test methods for defining the performance and flying qualities characteristics of high performance fixed wing aircraft. This laboratory experience serves as a final project for Aero Engr 456, Flight Test Techniques. Students receive credit for this course by participating in a field trip to Edwards AFB, flight test sortie in a high performance aircraft, creation of a written report, and presentation of a final briefing. This course will be scheduled during the same class period as Aero Engr 456. Coreq: Aero Engr 456 and department permission. Sem hrs: 1 fall or spring.

Aero Engr 457. Aircraft Feedback Control Systems. 3(1). 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. Final exam. Prereq: Aero Engr 352. Sem hrs: 3 fall or spring.

Aero Engr 466. Propulsion II. 3(1). Analysis of advanced aircraft engines. Preliminary aerodynamic and structural design of major engine components including inlets, compressors, combustors, turbines, mixers, afterburners, and nozzles. Final exam. Prereq: Aero Engr 361. Sem hrs: 3 fall.

Aero Engr 471. Aeronautics Laboratory. 3(2). 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. Labs. Final report. Prereq: Aero Engr 341 and El Engr 231. Coreq: Math 356. Sem hrs: 3 fall or spring.

Aero Engr 481. Introduction to Aircraft and Propulsion System Design. 3(2). 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 during the course. Final report. Prereq: Aero Engr 341 and Aero Engr 351. Coreq: Engr Mech 330 and Aero Engr 361. Sem hrs: 3 fall.

Aero Engr 482. Aircraft Design. 3(2). 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 during the course. Final report. Prereq: Aero Engr 352, Aero Engr 481, and Aero Engr 342 (or department permission). Sem hrs: 3 spring.

Aero Engr 483. Aircraft Engine Design. 3(2). 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. This course will include, if possible, a voluntary field trip to a government/industry design facility. Final report. Prereq: Aero Engr 466 and Aero Engr 481. Sem hrs: 3 spring.

Aero Engr 495. Special Topics. 1-3(1-2). Selected topics in aeronautical engineering. Final exam or final report. Prereq: Department permission. Sem hrs: 1-3 fall or spring.

Aero Engr 499. Independent Study. 3(0). Individual study and research supervised by a faculty member. Topic established with the department head. Final report. Prereq: Department permission. Sem hrs: 3 fall or spring.

- Aero Engr 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Aero Engr 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.
- Aero Engr 499C. Independent Study. 1(0). Sem hrs: 1 fall or spring.

AIRMANSHIP (Armnshp)
Offered by the 306 Flying Training Group (306 FTG)

Armnshp 251. Soaring Student. 0(3). Ground school, sailplane flight training. Offered in the summer and both semesters during the academic day. Completion during summer fills one military training requirement. Pass/fail. Sem hrs: 0 summer, fall or spring.

Armnshp 425. Academy Flight Screening (AFS). 3(4). AFS is an AETC flight screening program. All prospective pilot candidates must complete AFS prior to the SUPT start date. Criteria for course enrollment: 1) Must be PQ, PQ waiverable, or still waiting to take the graduation physical; 2) Must have an AFSC of pilot, be on the pilot alternate list, or prior to AFSC selection, planning to be a pilot. This course is not open to those who have already picked an AFSC other than pilot. In addition, cadets who have passed their FAA checkride for a Private Pilot License are ineligible to take the course (PPL holders are AFS-waived and do not need to take AFS prior to attending SUPT). AFS can be taken during the 2° spring, summer before the 1° year, or 1° fall. Cadets cannot be enrolled in other airmanship or flying programs while participating in AFS without specific approval from the Dean of Faculty, the Commandant of Cadets, and coordination with the 306 FTG. Cadets who decline pilot training after starting AFS will be removed from the course. Cadets who drop AFS after starting, or cannot meet requirements, will never again be eligible to attend SUPT. Cadets are given approximately 25

hours of flying training consisting of 19 sorties and 2 solo flights. Prereq: PQ or PW; plan to be a pilot in the AF. Pass/fail. Sem hrs: 3 fall, spring, or summer.

Armnshp 450. Airplane Rating, Private. 0(0). Dual and solo flight training to complete the requirements for an FAA Private Pilot Certificate. This training is conducted at the USAFA Aero Club at the cadet's expense (some subsidy is available from the Cadet Aviation Club). Formal course enrollment by academic advisor not required. Pass/fail. Sem hrs: 0 summer, fall or spring.

Armnshp 454. Navigator Academy Flight Screening (NAFS). 1(2). This course is only open to cadets who are Navigator Qualified and do not possess a private pilot license. Students enrolled in Armshp 251 (Soaring Student) or Armnshp 472/473 (Glider Instructor Upgrade Program) will not be allowed to enroll in NAFS. NAFS is a flight training course designed to develop aviation skills required for success at Joint Specialized Undergraduate Navigator Training (JSUNT). Missions expose cadets to aviation and navigation concepts to include interpreting weather data, utilizing radio navigation systems and performing flight planning, decision making, course/heading control, and time control. All sorties will be flown with a flight instructor. Requirements include: 1.0 hour of night flight and 8.0 hours of cross-country flight (in 3 sorties). C1C Standing. Pass/fail. Sem hrs: 1 summer, fall, or spring.

Armnshp 460. Airplane Rating, Commercial. 0(1). Dual and solo flight training to complete the requirements for an FAA Commercial Pilot Certificate. This training is conducted at the USAFA Aero Club at the cadet's expense (some subsidy is available from the Cadet Aviation Club). Formal course enrollment by academic advisor not required. Prereq: Armnshp 450 or FAA Private Pilot Certificate. Pass/fail. Sem hrs: 0 summer, fall or spring.

Armnshp 461. Cadet Soaring Instructor Upgrade. 3(2). Current ground school instruction consists of 42 classroom hours and is taught by 94 FTS officer personnel. The ground school lessons follow a sequential path for becoming a cadet instructor, starting with the basics of the airplane and finishing with an FAA exam for a private glider pilot’s license and check ride preparation. The flying portion of this course includes approximately 90 sailplane sorties. The course is offered in the fall and spring semesters of the three degree year, and is a prerequisite to Armnshp 472/473/474/475. Final project is a qualification check ride. Pass/fail. Sem hrs: 3 fall or spring.

Armnshp 465. Precision Flight Training – USAFA Flying Team. 0(2). Selected cadets receive training in precision landings, cross-country navigation, aircraft preflight, instrument flying, message drop, aircraft identification, Federal Aviation Regulations, Aeronautical Information Manual, and USAF flying regulations. Qualified cadets may participate in national and international flying competitions. During the first summer following their selection for the competitive team, cadets spend the third summer period qualifying in the team's aircraft. During the spring semester, the Flying Team is considered a mission-essential activity. Pass/fail. Prereq: Federal Aviation Administration (FAA) Private Pilot Certificate, not on Academic Probation, minimum entry GPA 2.5 (sem or cum). Sem hrs: 0 summer, fall or spring.

Armnshp 470. Airplane Rating, Instrument. 0(0). Dual flight instruction to complete the

requirements for an FAA Instrument Pilot Rating. This training is conducted at the USAFA Aero Club at the cadet's expense (some subsidy is available from the Cadet Aviation Club). Formal course enrollment by academic advisor not required. Prereq: Armnshp 450 or FAA Private Pilot Certificate. Pass/fail. Sem hrs: 0 summer, fall or spring.

Armnshp 472. Soaring Instructor. 0(3). Selected cadets serve as instructors in Armnshp 251. Completion during summer fulfills a military training leadership option. Cadets performing Cadet Soaring Instructor Duty will not be eligible to perform Aviation Instructor Duty except by written permission of 94 FTS and 50 TS. Pass/fail. Prereq: Armnshp 461. Sem hrs: 0 summer, fall or spring.

Armnshp 473. Cadet Soaring Instructor Duty. 0(1). Selected cadets serve as instructors in Armnshp 461. Cadets performing Cadet Soaring Instructor Duty will not be eligible to perform Aviation Instructor Duty except by written permission of 94 FTS and DFMI. Pass/fail. Prereq: Armnshp 472. Sem hrs: 0 fall or spring.

Armnshp 474. Cross Country Soaring. 0(3). Ground school to include regulations, planning, weather, thermalling techniques, competition rules, and equipment use. Flight training includes precision and off field landings, thermalling techniques, and dual/solo cross-country and competition sorties. Training camp at a deployed location during 'Dead Week'. Qualified cadets may be selected to travel to regional and national cross-country soaring competitions. Third-class cadets will be scheduled for 2 summer periods of AM-474 plus Operation Air Force. Second-class team members will be scheduled for 2 summer periods of AM-474. Pass/Fail. Prereq: Armnshp 472, selected by 94 FTS Advance Programs Commander. Sem hrs: 0 spring, summer.

Armnshp 475. Glider Aerobatics. 0(3). Ground and flight instruction to include spins, aerobatic maneuvers, precision flying techniques, and competition rules towards attaining USAFA Cadet Spin IP and Demonstration Pilot ratings. Training camp at a deployed location during Spring Break. Qualified cadets may be selected to travel to regional and national aerobatic competitions, air shows, and participate in home football game aerial demonstrations as part of the Academy's Soaring Demonstration Team. Third-class cadets will be scheduled for 2 summer periods of AM-475 plus Operation Air Force. Second-class team members will be scheduled for 2 summer periods of AM-475. Pass/Fail. Prereq: Armnshp 472, selected by 94 FTS Advanced Programs Commander. Sem hrs: 0 spring or summer.

Armnshp 480. Airplane Rating, Flight Instructor. 0(0). Dual flight training to complete the requirements for an FAA Flight Instructor, Airplane, Rating. This training is conducted at the USAFA Aero Club at the cadet's expense (some subsidy is available from the Cadet Aviation Club). Formal course enrollment by academic advisor not required. Prereq: Armnshp 460 or FAA Commercial Pilot Certificate. Pass/fail. Sem hrs: 0 summer, fall or spring.

Armnshp 490. Parachuting Student. 0(2). Instruction in basic free fall parachuting and familiarization with emergency parachuting as it pertains to future Air Force careers. Successful completion results in award of basic parachutist rating and badge (USAF PDS Code 4HY). Completion during summer fills one military training requirement. Pass/fail. Prereq: Not on

any probations. Sem hrs: 0 summer or spring.

Armnshp 491. Advanced Parachute Training. 0(2). Ground and aerial training which allows cadets to progress from initial free fall qualification to advanced free fall techniques, controlled body maneuvers, and precision landings. Introduction to instructional techniques, jumpmaster procedures, competitive parachuting and transition to Ram Air Canopies. (Cadets upgrading to Cadet Parachuting Instructor Duty are not eligible to enroll in any other Academy Aviation or Armnshp course during the same semester they enroll in AM-491.) Pass/fail. Prereq: Armnshp 490, 98 FTS approval, not on any probation, AOC and academic advisor approval, minimum entry MPA 2.50, PEA 2.60, GPA 2.60 (Sem or Cum), and C2C or C3C in good standing. Sem hrs: 0 fall.

Armnshp 492. Jumpmaster/Instructor Training. 3(2). Introduces selected cadets to jumpmaster procedures and instructional concepts. Course instruction follows a sequential path for becoming a cadet instructor/jumpmaster. This progression affords the cadets with advanced instruction in concepts and procedures required of USAFA jumpmasters and parachuting instructors. Participation in a spring deployment is mandatory. Cadets upgrading to Cadet Parachuting Instructor Duty are not eligible to take any other aviation or airmanship courses during the same semester they are enrolled in AM-492. Students must successfully complete a qualification check ride and a final written exam requiring a minimum of 85% to pass. Prereq: Armnshp 491, 98FTS approval, not on any probation, AOC and academic advisor approval, minimum entry MPA/PEA/GPA 2.6 (Cum or Sem), and C2C or C3C in good standing. Sem hrs: 3 spring.

Armnshp 496. Parachuting Instructor. 0(2). Selected cadets who wish to serve as instructors and jumpmasters for Armnshp 490 and upgrade courses. Cadets participate in competitive parachuting events and parachute demonstrations throughout the United States. (Cadets performing Cadet Parachuting Instructor Duty are not eligible to train as instructors in any other Academy Aviation or Airmanship courses.) Completion during summer fulfills a military training leadership requirement. Pass/fail. Prereq: Armnshp 492 and 98 FTS approval, not on any probation, AOC and academic advisor approval, minimum entry MPA/PEA/GPA 2.6 (Cum or Sem), and C1C or C2C in good standing. Sem hrs: 0 summer, fall or spring.

AREA STUDIES (Area Stu)

Offered by various departments within the Humanities and Social Sciences Divisions.

Area Studies 495. Special Topics in Area Studies. 3(1). Interdisciplinary Course. This course is intended to serve as a capstone for those specializing in the study of a particular region of the world (the suffix indicating region of specialization: "A" for Asia, "E" for Europe, "F" for Africa, "L" for Latin America, "M" for Middle East, "N" for North America, "S" for the former Soviet Union and Eastern Europe and "W" for Western Europe). Cultural, literary, historical, political, social, economic, geographic, 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 language. Paper or final. Normally taken during the first-class year. Sem hrs: 3 fall or spring.

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

Astro Engr 201. Technology Skills for Astronautics. 1(1). A self-paced course designed to provide the programming, modeling, and simulation skills required in the various courses in the Astro Engr major. Students will be introduced to the MatLab/Simulink 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 using the various tools must be completed over the course of the semester. Prereq: Comp Sci 110. Coreq: Astro Engr 310. Sem hrs: 1 fall or spring. Pass/fail.

Astro Engr 310. Introduction to Astronautics. 3(1). Introduction to the history, principles, and challenges of space. Elements of space missions are examined including orbits, spacecraft systems, launch vehicles, re-entry, operations, and mission management. Emphasis is placed 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. Concepts are reinforced through hands-on use of application-based analysis and visualization software and communication of these learned principles through written reports. Final exam. Prereq: Math 142, Engr 100, and Physics 110. Sem hrs: 3 fall or spring.

Astro Engr 321. Astrodynamics. 3(1). An intermediate course in orbit mechanics. Topics include orbit determination and prediction, orbit maneuvers, perturbations, rendezvous and proximity operations. Emphasis is on the design and use of structured computer programs to solve real-world astrodynamics problems. Programming experience is recommended. Final exam. Prereq: Astro Engr 201, Astro Engr 310, and completed or enrolled in Engr Mech 320 or Physics 355. Sem hrs: 3 fall or spring.

Astro Engr 331. Space Systems Engineering. 3(2). Fundamentals of space vehicle design are presented with an emphasis on systems engineering. Introduction to system-level spacecraft design issues are covered including reliability, environments, radiation effects, testing, materials engineering, integration, launch vehicles, and operations. Introduction to and analyses of payloads, structures, propulsion, electrical power, communications and data handling, attitude determination and control, and thermal control subsystems are also covered. The course includes an integrated lab experience where small teams analyze and integrate subsystems into a functioning small satellite called "EyeasSat." Each team demonstrates and documents their EyeasSat at the system level as a part of the final evaluation. Final report or final exam. Prereq: Astro Engr 310 or department permission. Sem hrs: 3 fall or spring.

Astro Engr 351. Rocket Propulsion. 3(1). Introduction to rocket propulsion and propulsion system design. The basic laws of thermodynamics, thermochemistry, and conservation are used to determine ideal motor performance. Emphasis is placed on describing the components and conceptual design criteria for liquid, solid, and hybrid rockets. Electric, nuclear, and other advanced propulsions systems are also studied. Final exam or final project. Prereq: Astro Engr 310 and Aero Engr 241. Sem hrs: 3 fall or spring.

Astro Engr 422. Advanced Astrodynamics. 3(1). A continuation of Astro Engr 321. The course 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. Least Squares and Kalman filter estimation techniques are applied to the orbital prediction problem using batch and sequential processing. Structured computer programming is used extensively in problem solutions. Final exam. Prereq: Astro Engr 321. Sem hrs: 3 spring.

Astro Engr 423. Space Mission Design. 3(1). Basic mission design principles for Air Force and civilian launch systems are examined. Mission objectives and constraints; feasibility studies; time-line generation; launch, on-orbit, and recovery operations; and contingency planning are studied. Structured computer programming is applied to analyze typical space missions. Final project. Prereq: Astro Engr 321. Sem hrs: 3 fall.

Astro Engr 431. Aerospace Systems Engineering Design. 3(1). An introduction to systems engineering design process. Cadets complete design of project supporting current department aerospace research efforts. Projects require attention to the engineering technical details of systems design as well as the economic, management, and social aspects of the process. Final report and briefing. Prereq: C1C standing, completed or enrolled in the engineering core. Sem hrs: 3 fall or spring.

Astro Engr 436. Small Spacecraft Engineering I. 4(2). An 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. Final project or report. Prereq: C1C standing and department permission. Sem hrs: 4 fall.

Astro Engr 437. Small Spacecraft Engineering II. 4(2). 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. Final project or report. Prereq: C1C standing, Astro Engr 436, and department permission. Sem hrs: 4 spring.

Astro Engr 443. Digital Control Theory and Design. 3(1). Introduction to the theory and implementation of digital control systems. Topics include analysis of sampled data systems, z-transform theory, design techniques using discrete equivalents, and direct digital design methods. Emphasis is placed on the design of digital control systems using microcomputers. Final project. Prereq: Engr 342 or El Engr 333 or department permission. Computer projects require programming proficiency; students without programming experience should contact the Course Director before enrolling. Sem hrs: 3 fall.

Astro Engr 444. Modern Control Theory and Design. 3(1). Introduction to advanced control techniques. Topics include state-space fundamentals, state feedback control, optimal control methods, and estimation theory. Additional topics may include nonlinear control, adaptive methods, and robust control methods. Methods are applied to the design of control systems for aircraft and spacecraft. Final project. Prereq: Math 346 and Engr 342 or El Engr 333, or

department permission. Computer projects require programming proficiency. Sem hrs: 3 spring.

Astro Engr 445. Spacecraft Attitude Dynamics and Control. 3(1). 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. Final project or final exam. Prereq: Engr Mech 320 or Physics 355; completed or enrolled in Engr 342. Includes analysis and synthesis with MATLAB™ simulation. Sem hrs: 3 fall or spring.

Astro Engr 446. Space Navigation. 3(1). Inertial navigation including studies of the accelerometers and gyroscopes used in strapdown 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 cadets enrolled in both Astro Engr 445 and Astro Engr 446 the suggested sequence is Astro Engr 445 first followed by Astro Engr 446. Final project. Prereq: Engr 342; Engr Mech 320 or Physics 355. Sem hrs: 3 spring.

Astro Engr 452. Rocket Engineering I. 4(2). An introduction to 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. The course relies on analysis and synthesis tools and techniques developed previously in the areas of structures, dynamics, propulsion, control, instrumentation, and computer simulation. Field trip and lab. Final project report. Prereq: C1C standing, completed or enrolled in Astro Engr 351, and department permission. Sem hrs: 4 fall.

Astro Engr 453. Rocket Engineering II. 4(2). A second course in rocket systems engineering. Final project report. Prereq: C1C standing, Astro Engr 452, and department permission. Sem hrs: 4 spring.

Astro Engr 495. Special Topics. 1-3(1). Selected topics in astronautics. Final exam or final report. Prereq: Department permission. Sem hrs and offering time determined by department (not more than 3 sem hrs).

Astro Engr 499. Independent Study. 3(0). Individual study and research supervised by a faculty member. Topic established with the department head. Final report. Prereq: Department permission. Sem hrs: 3 fall or spring.

- Astro Engr 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Astro Engr 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.
- Astro Engr 499C. Independent Study. 1(0). Sem hrs: 1 fall or spring.

Astro Engr 543. Methods of Optimization for Engineers. 3(1). Course in optimization methods

taught at graduate level. Topics include parameter optimization, optimization for dynamic systems, optimal control and numerical solutions. Final exam. Prereq: Math 346, Math 356 and Engr 342 or either El Engr 333 or Mech Engr 325 with Course Director approval. Computer projects require programming proficiency. Sem hrs: 3 spring.

AVIATION

Offered by the Department of Military Strategic Studies (DFMI)

Aviation 495. Special Topics in Aviation. 1-3(1). Selected special topics courses in aviation. Final exam or final report. Semester hours and offerings determined by DFMI.

Aviation 498. Aviation Instructor Duty. 0(2). Laboratory application of the principles taught in Aviation 493. This course will qualify cadets to assist instruction in MSS 100, teach and maintain proficiency in T-37 and FS-200 flight simulators, and provide extra instruction in additional Aviation courses. Additionally, cadets will be checked out as instructors in the T-41 TACAV program. This course develops and enhances officership and leadership skills in the classroom, simulator, and aircraft environment. Minimum of 50 contact hours with Aviation programs per semester required for proficiency. All contact time and T-41 training will be accomplished during concurrent periods (two hours total). Students gain first-hand knowledge of Air Force current operations on field trip to an operational Air Force base. Summer period enrollment fulfills military training requirement. Enrolled cadets not eligible to perform Airmanship Instructor Duty (Soaring or Parachute Duty) except with written permission from DFMI and the 94 FTS or 98 FTS, as applicable. Pass/Fail. Prereq: Course Director approval and Aviation 493. Sem hrs: 0 summer, fall, or spring.

Aviation 499. Independent Research and Study. 3(0). Individual study and research in Aviation under the direction of a 50 TS academic instructor. Final project. Prereq: Department permission. Sem hrs: 0 fall or spring.

BEHAVIORAL SCIENCES (Beh Sci)

Offered by the Department of Behavioral Sciences and Leadership (DFBL)

Beh Sci 110. An Introduction to Behavioral Sciences for Leaders. 3(1). This course provides an introduction to the scientific study of human behavior and mental processes at the individual level, addresses fundamental knowledge about living and working in small groups (such as families or military units), and introduces the student to sociology and anthropological perspectives on the structure and function of larger social groups. The course makes extensive use of experiential exercises that reinforce psychological principles and leadership skills that complement basic concepts. Final exam. Prereq: None. Sem hrs: 3 spring or fall.

Beh Sci 310. Foundations for Leadership and Character. 3(1). This course explores leadership and the development of high moral character—leaders and followers accountable and responsible—as a scientific study. An historical examination of the empirical basis for the scientific study of leadership will be combined with experiential exercises, case studies, and student projects that allow students to form a deeper understanding of leadership styles and strategies. Students will also gain practical knowledge and skills that will have direct benefits as

cadets and future officers. Students, through action, observation, and reflection, will learn to discern the situations and contexts within which leaders with character can flourish. Final exam and/or final project or paper. Prereq: Mgt 200. Sem hrs: 3 fall or spring.

Beh Sci 320. Lifespan Development. 3(1). This course examines how people develop physically, psychologically, socially, and cognitively from birth to death. It explores changes that are universal and changes that are unique to specific individuals. Developmental theories explaining these changes are presented. The course also 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?" Final paper/project. Prereq: Beh Sci 110. Sem hrs: 3 spring.

Beh Sci 330. Abnormal Psychology. 3(1). Building upon students' understanding of personality and individual differences, this course examines the development, nature, and treatment of mental disorders. Special emphasis is placed upon understanding the biopsychosocial context of maladaptive behavior. Final paper. Prereq: Beh Sci 110. Sem hrs: 3 fall.

Beh Sci 331. Basic Research Methods and Statistical Tools. 3(2). Introduces the integrated approach to statistics and experimental psychology. Topics covered include basic research design, APA research report writing, SPSS data analysis, descriptive measures, hypotheses testing, and prediction models. Includes research projects developed by the cadets on a topic of interest for presentation. Lab. Final exam. Prereq: Beh Sci 110. Sem hrs: 3 fall.

Beh Sci 332. Advanced Research Methods and Statistical Tools. 3(2). Continues the integrated approach to statistics and experimental psychology, extending cadet experience into more complicated experimental designs. Advanced multivariate designs and statistical procedures are learned and applied in psychology and human factors experiments. Lab. Final project. Prereq: Beh Sci 110 and Math 300. Sem hrs: 3 spring.

Beh Sci 335. Learning and Memory. 3(2). How does experience affect performance? This is the central question that has confronted learning theorists for several millennia; it is a question which dominated psychology for most of its first century. This course will examine learning and memory from a variety of historical theoretical perspectives. Cadets will test learning and memory notions in the laboratory using rats and report their experimental findings. Lab. Final exam or final project. Prereq: Beh Sci 110. Sem hrs. 3 fall.

Beh Sci 340. Marriage and Family. 3(1). This course examines courtship, marriage, and family in a diverse American culture. Emphasis is placed on the strains inherent in the dynamic interaction of gender, work, and family roles with special attention paid to the situation of military families and possible impacts on mission. This course uses lecture/discussion, films, student reports, and visiting experts. Practically, this course is an important step in preparing the graduates for their own marriages as well as providing some understanding of the effect of family factors on the productivity of military members. Final project. Prereq: Beh Sci 110. Sem hrs: 3 fall or spring.

Beh Sci 350. Cultural Anthropology. 3(1). Examines seven major topics of cultural

anthropology from a unique problem-based approach: culture and meaning, the meaning of progress, the social construction of reality and identity, language and symbolic meaning, the function of ritual, social construction of hierarchy, and violent conflict. Accordingly, the course looks at human development from the earliest time to the present by employing archeology, physical anthropology (biological/ecological development), and both ethnology (comparative and historic study of cultures) and ethnography (study of specific cultures), to understand the learned practices of diverse groups of people. This comparative approach is geared to allow students to become dynamic "cultural practitioners" instead of simply cultural recipients. Material on ethnographic fieldwork, linguistics, kinship, social organization, and contemporary applications of anthropology will be examined. Final exam or final project. Prereq: None. Sem hrs: 3 spring.

Beh Sci 352. Social Psychology. 3(1). This course 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, prosocial 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. Final exam or final project. Prereq: Beh Sci 110. Sem hrs: 3 spring.

Beh Sci 355. Biopsychology. 3(2). Examines the biological and neurophysiological foundations of human and animal behavior. Emphasis is on central nervous system mechanisms which mediate processes such as learning and memory, language, intelligence, sleep and arousal, reward and punishment, and human mental disorders. Special consideration is given to sensation and perception and topics which impact human factors design concerns. Final Exam. Prereq: Beh Sci 110 and Biology 215. Sem hrs: 3 fall.

Beh Sci 360. Sociology. 3(1). Sociology is the systematic study of human social behavior and groups. Racism, sexism, social stratification, bureaucracy, religion, education, and socialization are but a few of the topics covered. Classroom discussions and interaction with others are stressed throughout the course. Practically, this course teaches cadets how to examine what is "really" going on around them. Final exam or final project. Prereq: None. Sem hrs: 3 fall.

Beh Sci 370. Cognitive Psychology. 3(1). This course provides an overview of cognitive psychology. Human cognitive processes are examined from an information processing approach, and will include topics such as perception, attention, memory, language processing, judgment and decision-making, and problem solving. Emphasis will be placed on practical applications cadets can use to become better students and officers. Final exam or final project. Prereq: None. Sem hrs: 3 spring.

Beh Sci 371. Aviation Psychology. 3(1). This course focuses on human performance and man-machine design issues in military and civilian aviation. Through a series of seminars, the student will review psycho physiological effects of flight (visual, vestibular, and fatigue effects), investigate human performance during flight, discuss air controller and cockpit crew interaction,

and review specific aircraft design issues from the human performance perspective. Final exam. Prereq: None. Sem hrs: 3 fall.

Beh Sci 373. Introduction to Human Factors. 3(1). This course examines the process, principles, and guidelines of human factors as they impact the design of systems used by people and provides an introduction to the Human Factors and Systems Design option. Emphasizes the interaction between human capabilities and limitations, the task, and the environment, as they relate to performance. Final exam. Prereq: Beh Sci 110. Sem hrs: 3 spring.

Beh Sci 375. Human Factors in Systems Failure. 3(1). This course is designed to provide a basic understanding of the criticality of human factors consideration in the design of systems. It will include examination of historical case studies of complex systems failures due to human error and human factors engineering design shortcomings. Case studies include civil and military systems failures. Focus is on the human factors causes cited in systems failures, analysis of human factors theory and systems theory applying to the cited causes, and student-designed systemic corrections directed toward the prevention of similar failures in subsequent system designs. Prereq: Beh Sci 373. Final exam/project. Sem hrs: 3 spring.

Beh Sci 377. Industrial-Organizational Psychology. 3(1). Using concepts from several disciplines of psychology, this course provides a systematic study of job related behavior and an overview of the behavior of individuals at work by exploring work behaviors and related variables as part of a complex open system. Topics in personnel (industrial) psychology include analyzing jobs, matching individuals to jobs via selection or socialization, and training and performance evaluation. The second half of the course concentrates on the social context of work, and investigates motivation, job satisfaction, leadership, organization theory, personality, stress, and absenteeism and turnover. Final exam and/or final paper. Prereq: Beh Sci 310. Sem hrs: 3 fall.

Beh Sci 380. Theories of Personality. 3(1). Examines major theories of personality including dispositional, biological, psychoanalytic, phenomenological, and cognitive/learning approaches. Theories are examined with respect to concepts of personality development, assessment techniques, research methodologies and applications to current issues. Final exam. Prereq: Beh Sci 110. Sem hrs: 3 fall.

Beh Sci 385. Sports Psychology. 3(1). This course examines the science of psychology and the study of behavior as it relates to sport. Topics include the influence of personality, anxiety/arousal, motivation, aggression, attention/concentration, cognition/imagery, leadership, and other social-psychological dynamics on sport performance. Focus will be on the study of these concepts through reading, discussion, observation and experimentation. Final project. Prereq: None. Sem hrs: 3 fall.

Beh Sci 390. Sensation and Perception. 3(1). This course will provide 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 will introduce 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. Prereq: Beh Sci 110. Final project or final exam. Sem hrs: 3 spring.

Beh Sci 410. Advanced Topics in Leadership. 3(1). Capstone seminar course in Leadership and Organizations option. This advanced course explores the current trends and theories in leadership and leadership development from a scientific perspective, centering on the concepts of Transformational leadership, values-based leadership, servant leadership, and emotional intelligence, among others. Case studies, facilitated and student-led round-table discussions, projects, and experiential exercises will allow the students to gain an in depth understanding of leadership and its application across a variety of situations and contexts. Final exam and/or final project or paper. Prereq: Beh Sci 310; C1C standing or Department Head approval. Sem hrs: 3 spring.

Beh Sci 430. Tests and Measurement. 3(1). This course is designed to provide a basic understanding of the field of testing and measurement. The terminology, procedures, and basic psychometric properties inherent in assessment procedures will be discussed. Various types of assessment instruments will be introduced. A focus will be placed 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. This course will present 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. Prereq: Beh Sci 110. Final project. Sem hrs: 3 fall even-numbered years.

Beh Sci 460. Advanced Topics in Sociology and Anthropology. 3(1). An advanced course designed to explore specialized topics in sociology and anthropology 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. This course is designed primarily for the advanced student and will be conducted through a seminar/discussion model. Final exam or final project. Prereq: Beh Sci 350, Beh Sci 360, or department approval. Sem hrs: 3 spring.

Beh Sci 470. Advanced Topics in Cognitive and Bio-Psychology. 3(1). An 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. This course is designed primarily for the advanced student and will be conducted through a seminar/discussion model. Final exam or final project. Prereq: Beh Sci 355, Beh Sci 370, or department approval. Sem hrs: 3 spring.

Beh Sci 471. Engineering Psychology. 3(1). This advanced course examines cognitive and human performance theory with the aim of improving the design of human-machine interactions.

Further attention is given to the way humans sense and perceive information in the world. The course presents a functional model of human information processing with an emphasis on how people attend, perceive, think, remember, decide, and respond within a human-machine context. Emphasis is placed on designing systems compatible with the way humans process information. Final paper or final exam. Prereq: Beh Sci 373. Sem hrs: 3 fall.

Beh Sci 472. Human-Computer Interaction. 3(1). Survey of human-computer interaction concepts, theory, and practice. An interdisciplinary approach is implemented with emphasis on usability methods and the user-interaction-development process. This course will examine basic components of human-computer interaction from a user-centered perspective and examine computer-based technology from two thrusts: human (cognitive, social) and technological (input/output, interactions styles, devices). It considers iterative development of user interaction design, including user requirements gathering, with emphasis on design guidelines, evaluation methods, participatory design, and communication between users and system developers. Application of material will consider support of human decision aiding processes, including military command and control systems contexts. Programming experience desired, not required. Prereq: Comp Sci 110, Beh Sci 373, or department permission. Final project. Sem hrs: 3 fall.

Beh Sci 473. Human Factors in Systems Design. 3(2). This capstone course emphasizes the role and responsibilities of the human factors engineer in the design and evaluation of systems. The course uses a combination of group, individual, and in-class design projects to explore the system design process. Particular attention is given to human characteristics and their effects on system performance. Final project. Prereq: Beh Sci 471. Sem hrs: 3 spring.

Beh Sci 480. Advanced Topics in Personality and Social Psychology. 3(1). An 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. This course is designed primarily for the advanced student and will be conducted through a seminar/discussion model. Final exam or final project. Prereq: Beh Sci 352, Beh Sci 380, or department approval. Sem hrs: 3 fall.

Beh Sci 490. Individual and Group Counseling. 3(1). Integrating material across the Behavior Sciences, this course examines the helping process from the four major counseling paradigms. Treatment strategies will be linked to their respective counseling systems and to the primary theories from which they are derived. Highlighted throughout the course will be the significance of helping relationships in providing symptom relief and fostering change in both individual and formal group settings. Final paper. Prereq: Beh Sci 380. Sem hrs: 3 spring.

Beh Sci 495. Special Topics. 1-3(1). Selected topics in the Behavioral Sciences. Final Exam or Paper. Prereq: Department permission. Sem hrs and offering time determined by DFBL (not more than 3 sem hrs).

Beh Sci 499. Independent Study. 3(0). Research or practicum in a specific area of behavioral science. Conducted on a tutorial basis. Final paper. Prereq: Department permission. Sem hrs: 3 fall or spring.

- Beh Sci 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Beh Sci 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.
- Beh Sci 499C. Independent Study. 1(0). Sem hrs: 1 fall or spring

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

Biology 215. Introductory Biology with Lab. 3(2). An overview of biological systems, their structure and function, and the concepts and vocabulary essential to understanding biology today. Course content includes recent biological advances ranging from genetic engineering to human health and performance, from a survey of organisms to integrated global ecology and environmental science. Impacts on personal decision-making as well as on Air Force planning and operations are included. Laboratory investigations highlight the scientific method and basic biological concepts. Final exam. Prereq: Chem 141. Sem hrs: 3 fall or spring.

Biology 260. Strategies for Health. 3(1). Provides knowledge, insight, and decision-making skills needed by individuals in setting and reaching personal health goals as USAF officers. Topics introduced include nutrition, physical fitness, environmental health, mental health, stress management, sexuality, disease prevention/self-care, and special health issues affected by global travel. Students will learn how to improve their overall health, as well as those they will supervise during their careers. This course is suitable for cadets majoring in any academic discipline, including divisional majors or other programs. Final exam. Prereq: Biology 215. Sem hrs: 3 spring.

Biology 320. Biomechanics. 3(1). A study of the physical, anatomical, mechanical, and physiological basis for motion focused on the human. Joint and muscle physiology will be explored as a basis for functional activities. Physics and mechanical engineering concepts will be applied to describe, investigate, and compare the ways we initiate and control movement. Students will also learn the effects musculoskeletal injury may have on normal motion. Final exam. Prereq: Biology 215 and Engr Mech 120. Sem hrs: 3 spring.

Biology 330. Zoology. 3(2). An 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. Final exam. Prereq: Biology 215. Sem hrs: 3 fall or spring.

Biology 331. Botany. 3(2). An integrated study of the biology of plants is presented form 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 this course focuses primarily on seed plants, other programs 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. Final exam. Prereq: Biology 215. Sem hrs: 3 fall or spring.

Biology 332. Microbial Diversity. 3(1). 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. Final exam. Prereq: Biology 215. Sem hrs: 3 fall or spring.

Biology 345. Aerospace Physiology. 3(1). This course 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. This course is suitable for cadets majoring in any academic discipline, including the divisional majors or other programs. Optional field trip. Final exam. Prereq: Biology 215. Sem hrs: 3 fall.

Biology 350. Space Biology and Exploration. 3(1). This course introduces the environment of space as it relates to life. A central focus is the effect of space flight on living organisms, especially humans. Topics include: radiation and other hazards, the widespread effects of microgravity, life support needs, habitability issues, astronaut selection and training, and crew performance. We stress that space systems must balance biological needs, human-factors issues, demands, and design trade-offs. The course also explores the principles and possibilities of building long-term colonies, finding other habitable planets or "terraforming" nearby ones to support life, and even searching for true extraterrestrial life and intelligence. Throughout, students learn about key space programs and have the opportunity to interact with guest NASA speakers or other experts. The course is suitable for students with a variety of backgrounds and interests. Prereq: Bio 215. Final exam or project. Sem hrs: 3 spring.

Biology 360. Cell and Molecular Biology. 3(1). 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 biomolecules, organelles, membrane structure and transport, cellular respiration, photosynthesis, intercellular connections and communication, cell division, fertilization, and development. Fundamental cellular concepts will be illustrated and reinforced through discussions of gamete formation, specialized cells (e.g., muscle and nerve cells), eukaryotic-cell evolution, immunology, natural and man-made drugs and toxins (e.g., caffeine, cocaine, spider venoms, nerve gases), and various human pathologies (e.g., cancer, AIDS, multiple sclerosis, cystic fibrosis). Final exam. Prereq: Biology 215, and Chem 230 or 233 or concurrent enrollment recommended. Sem hrs: 3 fall or spring.

Biology 363. Genetics. 3(2). A comprehensive study of the inheritance patterns of individuals and populations, including the mechanisms by which these patterns are expressed and changed. Additional emphasis is on current technologies, including genetic engineering, their role in exploring the nature of life, and the ethical burden this has placed on society. Laboratory work stresses an understanding of classical and molecular aspects of genetics. Optional field trip. Final exam. Prereq: Biology 215, Chem 230 or 233 or concurrent enrollment. Sem hrs: 3 fall or spring.

Biology 370. Human Nutrition. 3(1). Provide a comprehensive, thoroughly updated account of nutrition principles and their application. This course 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. Course material will focus 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. Final exam. Prereq: Bio 215. Sem hrs: 3 fall.

Biology 380. Principles of Ecology. 3(1). Fundamental interrelationships between organisms and their environments, emphasizing energy flow through ecosystems, biogeochemical cycling, population dynamics, and community interactions. Emphasis is placed 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. Final exam. Prereq: Biology 215. Sem hrs: 3 fall or spring.

Biology 410. Anatomy and Physiology: Sensory and Motor Integration. 3(2). An introduction to human sensory and locomotory systems via experimentation and dissection of the human cadaver, with dissection emphasized. The course focuses on feedback mechanisms and the integration of organ systems for homeostasis and voluntary control. The following organ systems will be studied in detail: integumentary, skeletal, muscular, and nervous/sensory. Final exam. Prereq: Biology 215. Sem hrs: 3 fall.

Biology 430. Vertebrate Zoology. 3(2). A study of evolutionary origins, adaptations, characteristics, natural history, and classification of five major vertebrate groups: Fishes, Reptiles, Amphibians, Mammals, and Birds. Final exam. Prereq: Biology 330. Sem hrs: 3 fall of odd-numbered years.

Biology 431. Microbiology. 3(2). A study of 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. Final exam. Prereq: Biology 215, Chem 230 or 233. Sem hrs: 3 spring.

Biology 440. Anatomy and Physiology: Visceral Systems Integration. 3(2). An introduction to systems physiology via experimentation and dissection of the human cadaver, with experimentation emphasized. The course focuses on feedback mechanism and the integration of groan systems for maintenance of homeostasis. The following topics will be studied: autonomic nervous control, digestion, cardiovascular regulation, respiration, endocrinology, nephrology, reproduction, and immunology. Final exam. Prereq: Biology 215. Sem hrs: 3 spring.

Biology 464. Molecular Biology Methods. 3(2). A practical study of the methods and techniques used in the modern molecular biology and genetic engineering laboratory. Instructor-assisted laboratory exercises with complementary lectures will 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 will be included. Final exam or final project. Prereq: Biology 363, Chem 230 or 233. Sem hrs: 3 fall.

Biology 480. First-Class Biology Seminar. 3(1). A survey of experimental biology through seminars, presentations of journal articles, and discussions. Emphasis is on student participation and exploring areas of current biological importance. Students will choose and analyze research papers, present their findings in seminars, discuss the ethical implications of research, and experience the scientific literature inherent in modern biology. Final report. Prereq: C1C standing and Math 300. Sem hrs: 3 spring or fall.

Biology 481. Applied Ecology. 3(2). Lecture and laboratories that address 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 emphasize environmental issues that are of special interest to Air Force personnel. Includes field studies conducted on the Academy grounds. Field trip. Final exam and/or final project. Prereq: Biology 380 (coreq with department permission). Sem hrs: 3 fall.

Biology 495. Special Topics. 1-3(2). Selected topics in the biological sciences. Final exam or final report. Prereq: Announced each semester. Sem hrs and offering times determined by the department (not more than 3 sem hrs).

Biology 499. Independent Study. 3(0). 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. Prereq: Math 300, Cum GPA 3.0 and above (waiverable by department), and department permission. Sem hrs: 3 fall or spring.

- Biology 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Biology 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.
- Biology 499C. Independent Study. 1(0). Sem hrs: 1 fall or spring.

CENTER FOR CHARACTER DEVELOPMENT (CWC)

Offered by the Center for Character Development (34 TRW/CWC)

ACES. Academy Character Enrichment Seminar. The ACES program is an eight-hour (0730 - 1530) offsite seminar/workshop designed to focus attendees on the ethical demands placed on Air Force officers. Attendees are exposed to issues, concepts, and experiences designed to convey the importance of character and leadership development to the positive transformation of the Air Force and the Department of Defense. Participants engage in dialogue throughout the day that focuses upon both ethical development and mentorship skills within the Air Force core value framework. Graduation requirement scheduled during the first-class year.

LIFT. Leaders in Flight Today. The LIFT program is an eight-hour (0730 – 1600) offsite seminar/workshop designed to focus attendees on high performance team formation, including emphasis on individual leadership styles, interpersonal skills development, establishing trust and loyalty, mentorship, spiritual appreciation, and team leadership accountability. LIFT stresses character and leadership development using a variety of teaching tools and techniques, including use of a personality assessment, experiential learning activities, case study analysis, and small group facilitation. Graduation requirement scheduled during the second-class year.

R&R. Respect and Responsibility. This five-hour (1130 - 1630) workshop is designed to take the cadets out of their normal environment while helping them discover valuable information about themselves, others, and the interpersonal interactions that foster a healthy command environment. Students attempt a graduated series of activities, involving both emotional and physical risk, designed around human relations and diversity issues. The goals and benefits of the R&R Workshop are for participants to acknowledge differences and similarities in their own and others' leadership behaviors; appreciate the impact of respect, cooperation, and trust on problem solving, decision making, and leadership effectiveness; develop skills that foster and encourage open and honest communication; and to challenge views and biases that undermine a positive and productive work environment. Graduation requirement scheduled during the third-class year.

VECTOR. Vital Effective Character Through Observation and Reflection. This 3½-hour (1515 - 1850) interactive seminar focuses on personal self-reflection, where cadets examine their own Purpose, Vision, Values, and Influence. VECTOR illustrates to the fourth class cadets the importance of developing a strong personal foundation while further enhancing their own leadership styles. Attendees are exposed to various leadership styles and qualities in the form of an historical fiction-based movie, and are then challenged to form their own opinions on how they'll compare the character and leadership traits exemplified in the movie with their own styles, both here at USAFA and within the greater Air Force. Graduation requirement scheduled during the fourth-class year.

CHEMISTRY (**Chem**)

Offered by the Department of Chemistry (DFC)

Chem 141. Applications of Chemistry I. 3(2). Fundamental applications of chemistry with emphasis on the chemical concepts underlying those applications. Topics include atomic and molecular structure, electronic structure, oxidation-reduction reactions, stoichiometry, chemical bonding and structure, chemical analysis, environmental chemistry, and special topics. Chemical principles are taught within the framework of Air Force applications. Laboratories emphasize

both quantitative and qualitative analysis with computer interface for data collection and analysis. Final exam. Sem hrs: 3 fall.

Chem 142. Applications of Chemistry II. 3(2). A continuation of Chemistry 141. Topics include gas laws, thermodynamics, acids and bases, electrochemistry, kinetics, chemical equilibrium, biochemistry and special topics. Chemical principles are taught within the framework of Air Force applications. Laboratories emphasize both quantitative and qualitative analysis with computer interface for data collection and analysis. Final exam. Prereq: Chem 141. Sem hrs: 3 spring.

Chem 222. Analytical Chemistry. 3(2). Lecture and laboratory experience in quantitative analysis using both classical wet techniques and modern instrumentation. Topics include wet chemical methods, chromatography, spectroscopy, electrochemistry, and other advanced techniques. Final Exam. Prereq: Chem 142 or DFC permission. Sem hrs: 3 fall or spring

Chem 230. Introductory Organic Chemistry. 3(1). Introduction to the 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 cadets desiring to apply for medical school will not take this course in lieu of Chem 233 and 234. Final exam. Prereq: Chem 142 or equivalent; DFC permission required for enrollment in the spring semester. Sem hrs: 3 fall or spring.

Chem 233. Organic Chemistry I. 3(1). Classification and naming of organic compounds, synthesis and reactions of organic functional groups, stereochemistry, introduction to resonance, spectroscopy, and reaction mechanisms. Final exam. Prereq: Chem 142. Concurrent enrollment in Chem 243 is recommended but is optional for non-chemistry majors. Sem hrs: 3 fall.

Chem 234. Organic Chemistry II. 3(1). Continuation of the reactions of aliphatic and aromatic compounds and reaction mechanisms. Introduction to carbohydrates, polynuclear aromatics, heterocyclic compounds, amino acids and proteins, and multi-step syntheses. Final exam. Prereq: Chem 233. Concurrent enrollment in Chem 244 is recommended but is optional except for ACS approved Chemistry majors. A grade of "C" or better in Chem 233 is recommended to take Chem 234. Sem hrs: 3 spring.

Chem 243. Organic Chemistry Laboratory. 3(2). Experiments in the preparation, purification and identification of representative organic compounds. Introduction to gas phase chromatography, mass spectrometry, infrared spectroscopy, and nuclear magnetic resonance spectroscopy as applied to the identification of organic compounds. The lab is designed to illustrate the principles involved in Chem 233. Prereq: Completed or enrolled in Chem 233. Sem hrs: 3 fall.

Chem 244. Instrumental Organic Chemistry. 3(2). This is a continuation of Chem 243 and includes applications of infrared, proton magnetic resonance, mass spectra, and chromatographic

analysis of organic materials prepared 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 233 and Chem 234. Prereq: Chem 243 and completed or enrolled in Chem 234. Sem hrs: 3 spring.

Chem 325. Space Chemistry. 3(1). This course examines the integral role chemistry plays in our efforts to effectively utilize space. Topics may include the chemical evolution of the universe, materials science, propulsion chemistry and other subjects of current interest. Final exam or report. Prereq: Chem 142. Sem hrs: 3 fall.

Chem 335. Physical Chemistry I. 3(1) Fundamentals of chemical thermodynamics and equilibria involving gases, liquids, and solutions, the analysis of phase equilibria, electrochemistry, and chemical kinetics. Final exam. Prereq: Chem 142 and Math 243 (or Math 253). Math 245 is desirable and encouraged. Sem hrs: 3 fall.

Chem 336. Physical Chemistry II. 3(1). Fundamentals of quantum chemistry including computational applications, spectroscopy, statistical mechanics, properties of solids and liquids, transport properties, and surface chemistry. Final exam. Prereq: Chem 335. Sem hrs: 3 spring.

Chem 345. Physical Chemistry Laboratory. 3(2). Laboratory measurement of physical properties including thermodynamics of liquids and gases; thermochemistry of reactions; phase and chemical equilibria; colligative properties and spectroscopy. Precision of measurement, statistical treatment of data, and graphical techniques are emphasized. Prereq: Chem 335. Sem hrs: 3 spring.

Chem 350. Chemistry of Weapons. 3(1). The primary focus of this course 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 and current topics. Emphasis is on understanding the chemical principles and thermodynamic processes involved in a variety of current and future weapon systems. Final exam and/or final project. Prereq: Chem 142, completed or enrolled in any core energy/systems option course, or department permission. Sem hrs: 3 fall or spring.

Chem 353. Theory of Instrumental Methods of Chemical Analysis. 3(1). Basic theory and real-world examples of modern analytical methods of chemical analysis. Emphasis on theory of methods currently applied in advanced courses offered in the USAFA Department of Chemistry. 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. Final exam. Prereq: Chem 142. Sem hrs: 3 spring.

Chem 381. Chemistry of the Environment. 3(1). Discussion of the nature, chemistry and alteration of the environment. Areas of study include atmospheric, soil, and water pollution, waste disposal, biochemistry, toxicology and environmental analytical techniques, and special

topics of current or regional interest. Emphasis on understanding the chemical principles and reactions involved in protecting and improving our environment. Final exam or report. Prereq: Chem 142. Sem hrs: 3 spring.

Chem 431. Theoretical Inorganic Chemistry. 3(1). Theoretical approach to atomic structure, covalent bonding and molecular structures; ionic compounds; coordination chemistry to include organometallics; boron chemistry; transition metal chemistry and bio-inorganic; general survey of the periodic table. Inorganic synthesis. Final exam. Prereq: Chem 335. Sem hrs: 3 fall or spring.

Chem 432. Systematic Inorganic Chemistry. 3(1). Applications of Chem 431 with emphasis on a systematic study of the behavior of chemical elements and theoretical inorganic compounds. Chemistry of transition metals, organometallics, boron, bio-inorganic, fluxional molecules, kinetics and mechanisms of inorganic reactions and special topics. Final exam. Prereq: Chem 431. Sem hrs: 3 spring.

Chem 433. Advanced Organic Chemistry. 3(1). Chemical bonding and molecular structure; molecular orbital theory, aromaticity. Structure-reactivity, kinetics, mechanisms, and linear free energy relationships. Concerted reactions; conservation of orbital symmetry, frontier molecular orbitals, photochemistry. Selected synthetic methods; nucleophilic carbon species, carbonyl compounds. Principles of stereochemistry; asymmetric synthesis. Final exam. Prereq: Chem 234; Chem 335 or DFC permission. Sem hrs: 3 fall.

Chem 434. Biochemistry. 3(1). 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. Final exam. Prereq: Chem 234 and Chem 335. Sem hrs: 3 spring.

Chem 435. Advanced Physical Chemistry. 3(1). Development of molecular quantum mechanics and its application to molecular spectroscopy and chemical reaction dynamics. Spectroscopy topics include rotational, vibrational, and electronic spectroscopy. Chemical reaction dynamics study will emphasize theoretical calculations for reactions of Air Force interest using the best available theoretical chemical methods. Includes one field trip to an Air Force laboratory. Final exam. Prereq: Chem 336. Sem hrs: 3 fall or spring.

Chem 440. Polymer Chemistry. 3(2). An 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. Final exam. Prereq: Chem 233, Chem 243, and Chem 335, or DFC permission. Sem hrs: 3 spring.

Chem 445. Advanced Laboratory Techniques. 3(2). This course is designed to illustrate advanced laboratory techniques in inorganic, organic, analytical, and physical chemistry.

Experiments include preparation, purification, identification, and analysis of representative organic and inorganic compounds. Final project or final exam. Prereq: Chem 234 and completed or enrolled in Chem 431 or DFC permission. Sem hrs: 3 fall or spring.

Chem 453. Instrumental Methods of Chemical Analysis. 3(2). Advanced theory and application of modern analytical instruments for chemical analysis. Emphasis on theory as applied in laboratory instrumentation. Topics include ultraviolet, visible, infrared absorption and emission spectroscopies; nuclear magnetic resonance and electron paramagnetic resonance spectroscopy; chromatography; thermal methods; and electrochemical techniques. Final exam or final project. Prereq: Chem 335 or concurrent enrollment. Sem hrs: 3 fall.

Chem 465. Chemistry of Advanced Materials. 3(2). Chemical studies in topics that start with quantum mechanical models, then include materials for energy storage, electronics, structures, optics, and glasses. Chem 465 is a course for the Materials Science Track major, developed to emphasize physical chemistry fundamentals, the interface between molecules and materials, and laboratories on synthesis and characterization of materials. Final Exam. Prereq: Chem 335. Sem hrs: 3 spring.

Chem 481. Biochemistry I. 3(1). 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. Final exam. Prereq: Chem 234 and Chem 335 or DFC permission. Sem hrs: 3 fall

Chem 482. Biochemistry II. 3(1). 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. Final exam. Prereq: Chem 481. Sem hrs: 3 spring.

Chem 491. Biochemistry Laboratory. 3(2). 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. This lab is designed to illustrate the conceptual principles presented in Chem 481. Laboratory Practical Exam at semester's end. Final project. Coreq: Chem 481. Sem hrs: 3 fall.

Chem 492. Advanced Biochemistry Laboratory. 3(2). This class is a continuation of Chem 491 and supplements material covered in Chem 482. This course will emphasize advanced laboratory techniques in biochemistry. The class 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. A poster session and report are due at the end of the semester. Prereq: Chem 481 and Chem 491. Coreq: Chem 482. Sem hrs: 3

spring.

Chem 495. Special Topics. 1-3(1). Selected topics in chemistry. Final exam or final report. Prereq: DFC permission. Sem hrs and offering time determined by DFC (not more than 3 sem hrs).

Chem 499. Independent Study. 3(0). Individual research under the direction of a faculty member. Includes use of chemical literature. No final. Prereq: DFC permission. Sem hrs: 3 fall or spring.

- Chem 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Chem 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.

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

Civ Engr 210. Air Base Design and Performance. 3(1). Broad principles of engineering design (including technical, ethical, economic and socio-political consideration) applied to the environment, infrastructure, and combat support requirements for air bases during peacetime, humanitarian relief, small scale contingency, and combat operations. Guided by an integrated decision-making and system-design approach, cadets solve projects based on real AF problems to integrate the course material and their personal experience. Topics covered were validated based on survey of engineers, educators and operational AF officers. The topics include: environmental impact analysis (land use planning, environmental quality, and airspace issues), infrastructure (airfields, utilities, and facilities) and combat support with emphasis on beddown, force protection planning, and host nation support consideration. Three projects required. Prereq: Engr 100 and upperclass standing. Sem hrs: 3 fall or spring.

Civ Engr 215. Computer Applications for Civil Engineers. 3(1). 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. Final project. Sem hrs: 3 fall or spring.

Civ Engr 330. Elementary Structural Analysis. 3(1). Static analysis of determinate structures. Stresses and deformations in beams, trusses, and frames. Final exam. Prereq: Engr Mech 120 and completed or enrolled in Math 245. Sem hrs: 3 fall or spring.

Civ Engr 351. Civil Engineering Practices - Field Engineering. 3(0). This two-phase course includes Operation Civil Engineering Air Force (OpsCEAF) and a three week field experience at the USAFA Field Engineering and Readiness Laboratory (FERL). Secondclass 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. Cadets 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). OpsCEAF credit is Pass/Fail. Civ Engr 351 is graded. Prereq: Engr Mech 120 and department permission required for non-Civ Engr majors. Sem hrs: 3 summer (5 week course beginning after final exams).

Civ Engr 361. Fundamental Hydraulics. 3(1) 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. Final exam. Prerequisites: Engr Mech 120 and Civ Engr 351 or department permission. Sem hrs: 3 fall.

Civ Engr 362. Introduction to Environmental Engineering. 3(1). 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. Final exam. Prereq: Engr Mech 120. Coreq: Civ Engr 361. Sem hrs: 3 fall or spring.

Civ Engr 368. Hazardous Waste Management and Contaminant Transport. 3(1). A comprehensive introduction to the field of hazardous waste management and contaminant transport in the surface and subsurface environment. Topics include: environmental regulations, process fundamentals, hydrologic cycle, hydrologic measurement, hydrologic analysis of surface water, groundwater flow, fate and transport of contaminants in the surface and subsurface environment, and pollution prevention and waste minimization. The engineering planning and analysis associated with handling, storage, treatment, transportation and disposal of hazardous wastes is also covered. Technical paper. Final exam. Coreq: Civ Engr 362. Sem hrs: 3 spring.

Civ Engr 369. Introduction to Air Pollution. 3(1). 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 will involve several laboratory exercises. Final exam. Coreq: Civ Engr 362. Sem hrs: 3 fall.

Civ Engr 372. Behavior and Analysis of Structures. 3(1). 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. Final exam. Prereq: Civ Engr 330; Civ Engr 351 or department permission. Sem hrs: 3 fall or spring.

Civ Engr 373. Behavior and Design of Steel Members. 3(1). Behavior of structural steel beams, columns, and 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. Final exam. Prereq: completed or enrolled in

Civ Engr 372. Sem hrs: 3 spring.

Civ Engr 390. Introduction to Soil Mechanics. 3(2). Engineering properties of soils, soil classification, permeability, consolidation, compaction, shear strength and applications to engineering design. Soils laboratories and reports. Final exam or project. Prereq: Civ Engr 351 or department permission. Sem hrs: 3 fall or spring.

Civ Engr 405. First-Class Seminar. 0(1). 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 cadets may encounter in the Air Force after graduation. The course meets once per week. Open only to 1° Civil Engineering majors. Sem hrs: 0 spring. Pass/fail, no final.

Civ Engr 463. Wastewater Treatment Plant Design. 3(2). 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. Final design project consists of a complete municipal wastewater treatment plant design. Prereq: Civ Engr 362. Sem hrs: 3 fall.

Civ Engr 464. Architectural Design. 3(2). 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. Final project. Prereq: Civ Engr 215, Civ Engr 351 or department permission. Sem hrs: 3 fall and spring.

Civ Engr 467. Water Treatment Principles and Design. 3(1). Design of unit operations for coagulation, sedimentation, filtration and disinfection for treatment of drinking water. Introduce 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. Includes two complete design exercises. Final report. Prereq: Civ Engr 362. Sem hrs: 3 spring.

Civ Engr 468. Solid and Hazardous Waste Facilities Design. 3(1). 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. Prereq: Civ Engr 362. Sem hrs: 3 fall.

Civ Engr 469. Design of Air Pollution Controls. 3(1). 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. Prereq: Civ Engr 369. Sem hrs: 3 spring.

Civ Engr 473. Structural Design. 3(2). Design of a multi-story steel and reinforced concrete

building, including structural frame, floor and roof system, and foundation. Computer-aided analysis and design. Final report. Prereq: Civ Engr 373 and Civ Engr 474. Sem hrs: 3 spring.

Civ Engr 474. Behavior and Design of Concrete Members. 3(1). 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. Final exam. Prereq: Completed or enrolled in Civ Engr 372. Sem hrs: 3 fall.

Civ Engr 480. Project Management and Contract Administration. 3(1). This is the 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. Cadets take an owner's project requirements through stages of scope definition, budgeting and planning, conceptual design, scheduling and construction contract administration. Cadets apply engineering standards and consider realistic issues including engineering economics, constructability, environmental requirements, sustainability, and safety. The course concludes with a project competition involving construction industry professionals. Final project. Prereq: Mgt 200 and one of the following: Civ Engr 468, Civ Engr 474, Civ Engr 485, Civ Engr 491, or department permission. Sem hrs: 3 spring.

Civ Engr 485. Construction Project Management. 3(1). This course 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. Final project. Prereq: Mgt 200 or department permission. Sem hrs: 3 fall.

Civ Engr 488. Pavement Design and Transportation. 3(1). 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. Final exam or project. Prereq: Civ Engr 390. Sem hrs: 3 spring.

Civ Engr 491. Foundation Engineering. 3(1). Site investigation, analyses of excavation support, dewatering, bearing capacity and settlement, design of shallow and deep foundations. Final report. Prereq: Civ Engr 390. Sem hrs: 3 fall or spring.

Civ Engr 492. Earth Structures: Embankments, Slopes, and Buried Structures. 3(1). 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. Final report. Prereq: Civ Engr 390. Sem hrs: 3 spring.

Civ Engr 495. Special Topics. 1-3(1). Selected topics in civil engineering. Final exam or final report. Prereq: department permission. Sem hrs and offering time determined by department (not more than 3 sem hrs).

Civ Engr 499. Independent Study. 3(0). Individual study and research in an advanced civil

engineering topic approved by the department head. Final report. Sem hrs: 3 fall or spring.

- Civ Engr 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Civ Engr 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.
- Civ Engr 499C. Independent Study. 1(0). Sem hrs: 1 fall or spring.

COMPUTER ENGINEERING (Comp Engr)

Offered by the Departments of Electrical Engineering (DFEE) and Computer Science (DFCS)

Comp Engr 373. Digital VLSI Circuits. 3(2). A 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. Lab. Final exam. Prereq: El Engr 281 and El Engr 321. Sem hrs: 3 spring.

Comp Engr 463. 3(2). 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. Design project. Prereq: Comp Engr 373 and C1C standing, or department permission. Sem hrs: 3 fall.

Comp Engr 464. 3(2). 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. Emphasis is placed on system design, appropriate implementation in hardware and software, analysis, testing and evaluation, quality assurance, and documentation. The course uses a design project to emphasize Air Force applications. Final project. Prereq: Comp Engr 463 or department permission. Sem hrs: 3 spring.

COMPUTER SCIENCE (Comp Sci)

Offered by the Department of Computer Science (DFCS)

Comp Sci 110. Introduction to Computing. 3(1)*. An 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. Final exam. Prereq: None. Sem hrs: 3 fall or spring.

Comp Sci 210. Introduction to Programming. 3(2). 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. Final exam. Prereq: Comp Sci 110. Sem hrs: 3 fall.

Comp Sci 211. Introduction to Programming for Scientists and Engineers. 3(2). Introduces the fundamental techniques of software development as a foundation for solving engineering problems using computers. Topics include programming constructs, problem-solving strategies, algorithms, and data structures, with a focus on engineering applications. Considerable attention is devoted to developing effective software engineering practices, emphasizing design, decomposition, encapsulation, modularity, testing, debugging, and software reuse. Cadets will learn a programming language and development environment that is widely used within the engineering discipline. Final Exam. Prereq: Comp Sci 110. Sem hrs: 3 fall or spring.

Comp Sci 212. Introduction to Programming for Operations Research Majors. 3(2). 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, 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. Programming exercises will focus on numerical methods. Final exam. Prereq: Comp Sci 110. Sem hrs: 3 fall.

Comp Sci 220. Data Abstraction. 3(1). 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. Final exam. Prereq: Comp Sci 210 or Comp Sci 212. Sem hrs: 3 spring.

Comp Sci 310. Information Technology. 3(1). This course gives cadets the computing skills necessary 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. This course is suitable for cadets in any academic major, including divisional majors. Final project. Prereq: Comp Sci 110. Sem hrs: 3 fall of odd-numbered years.

Comp Sci 315. Web Design and Construction. 3(1). This course gives cadets experience 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. Final project. Prereq: Comp Sci 110. Sem hrs: 3 spring of odd-numbered years.

Comp Sci 351. Computer Organization and Architecture. 3(1). 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, datapath and control, pipelining, virtual memory, I/O, device drivers, and parallel processing. Final Exam. Prereq: El Engr 281 and Comp Sci 210 or department permission. Sem hrs: 3 spring.

Comp Sci 359. Programming Paradigms. 3(1). An applied course studying four different

programming paradigms. Imperative, Object-Oriented, Functional and Logic programming paradigms will be 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. Final exam. Prereq: Comp Sci 220. Sem hrs: 3 fall.

Comp Sci 362. Computer Simulation. 3(1). 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. Final project. Prereq: Comp Sci 210, Comp Sci 211, or Comp Sci 212. Sem hrs: 3 spring.

Comp Sci 364. Information Storage and Retrieval. 3(1). 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. Final exam. Prereq: Comp Sci 210, Comp Sci 211, or Comp Sci 212. Sem hrs: 3 spring.

Comp Sci 380. Design and Analysis of Algorithms. 3(1). 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. Final exam. Prereq: Comp Sci 220. Sem hrs: 3 fall.

Comp Sci 405. First-Class Seminar. 0(1). A course designed to give Computer Science majors the opportunity to discuss topics cadets may encounter in the Air Force upon graduation, including computer ethics. Leaders from around the Air Force are invited to speak in the classroom, offering their view of what it takes to be successful in the Air Force and the impact of technology in our career field. The course meets once per week. Open only to Computer Science majors. Pass/Fail. Coreq: Philos 310. Sem hrs: 0.5 fall.

Comp Sci 426. Languages and Machines. 3(1). Students will 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 will design and implement a syntax-directed compiler for a high-order programming language. Final exam. Prereq: Comp Sci 351. Sem hrs: 3 fall.

Comp Sci 431. Cryptography. 3(1). 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. Final exam. Prereq: Math 340; or Math 372 or Math 374 coreq; or department permission. Sem hrs: 3 spring.

Comp Sci 438. Computer Security and Information Warfare. 3(1). An introduction to the technical aspects of Information Warfare. Emphasis is on how 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. Final project. Prereq: Comp Sci 467. Sem hrs: 3 spring.

Comp Sci 453. Software Engineering I. 3(2). This is the 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. Final project. Prereq: C1C standing. Sem hrs: 3 fall.

Comp Sci 454. Software Engineering II. 3(2). This is the 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. Final project. Prereq: Comp Sci 453. Sem hrs: 3 spring.

Comp Sci 467. Computer Networks. 3(1). 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. Final exam. Prereq: Comp Sci 483 or department permission. Sem hrs: 3 spring.

Comp Sci 468. Network Security. 3(1). Focuses on the design and anlysis 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 honeynets, network intrusion detection, and computer forensics. The culmination of the course is an exercise where cadets design, configure, and secure a live network that is attacked by "Red Teams." Final project. Prereq: Comp Sci 467 or department permission. Sem hrs: 3 spring.

Comp Sci 471. Artificial Intelligence. 3(1). 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. The course will also explore current and projected uses of AI in the Air Force. Final exam. Prereq: Comp Sci 359. Sem hrs: 3 spring of odd-numbered years.

Comp Sci 474. Computer Graphics. 3(1). 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. Course includes several computer projects. Final exam or project. Prerequisite: Comp Sci 220. Sem hrs: 3 spring of even-numbered years.

Comp Sci 483. Operating Systems. 3(1). 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. Final exam. Prereq: Comp Sci 220. Sem hrs: 3 fall.

Comp Sci 495. Special Topics. 1-3(1). Selected topics in computer science. Final exam or final report. Prereq: Department permission. Sem hrs and offering time determined by department (not more than 3 sem hrs).

Comp Sci 496. Computer Science Seminar. 3(1). 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. Final report. Prereq: C1C standing and department permission. Sem hrs: 3 spring.

Comp Sci 499. Independent Study. 3(0). Individual study and research supervised by a faculty member. Topic established with the department head. Final report. Sem hrs: 3 fall or spring.

- Comp Sci 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Comp Sci 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.

ECONOMICS (Econ)

Offered by the Department of Economics and Geography (DFEG)

Econ 200. Introduction to Economics. 2(1). Introduces the economic way of thinking, emphasizing its critical importance in analyzing contemporary issues. Topics will include scarcity, price theory, markets, decision-making, environmental issues, the role of the government and the global economy. Includes a basic economic explanation behind the influence of political, social, legal, regulatory and technical issues. Incorporates experiments to examine human behavior and provide insight into real-world concerns. This course meets for 32 lessons, plus a final exam. Sem hrs: 2 fall or spring.

Econ 301. Macroeconomic Principles for the U.S. and the World. 3(1). 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. The focus of the course 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. Final exam or final paper. Coreq: Econ 200. Sem hrs: 3 fall.

Econ 332. Microeconomic Theory I. 3(1). The 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. Prereq: Econ 200. Final exam. Sem hrs: 3 fall.

Econ 333. Microeconomic Theory II. 3(1). The 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. Final exam. Prereq: Econ 332. Sem hrs: 3 spring.

Econ 340. Development of Economic Thought. 3(1). 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. This 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, you will have gained an appreciation of how today's economic theories have been influenced by the economic conditions that their originators experienced. Final exam or final paper. Prereq: Econ 355; Econ 333 is highly recommended. Sem hrs: 3 spring.

Econ 347. Quantitative Economic Methods. 3(1). Analysis of economic problems through statistical and mathematical methods and the use of quantitative models. Final exam. Prereq: Econ 332. Sem hrs: 3 fall.

Econ 351. Comparative Economic Systems. 3(1). An examination of the world's major economic systems including capitalism, market socialism, and planned socialism. Course will include both a theoretical approach and a case study analysis of contemporary economic systems. Among the countries evaluated will be the US, Eastern Europe, France, West Germany, Yugoslavia, China, and Japan. Final exam or final report. Prereq: Econ 332; Econ 355 is strongly recommended. Sem hrs: 3 fall.

Econ 355. Principles of Macroeconomics. 3(1). 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. Final exam or final paper. Prereq or Coreq: Econ 200 or Econ 332 (concurrent enrollment allowed with department permission). Sem hrs: 3 fall.

Econ 356. Macroeconomic Theory. 3(1). Analysis of national income, employment, price level determination, monetary, and fiscal policies. Contemporary macroeconomic issues are explored through the Economic Report of the President. Final exam. Prereq: Econ 355. Sem hrs: 3 spring.

Econ 365. Analysis of Empirical Economic Data. 3(1). Survey of economic data series available from the Economic Report of the President, Commerce Department, Bureau of Labor Statistics, Federal Reserve, and financial data. This course 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. Final exam or project. Prereq: Math 300. Sem hrs: 3 spring.

Econ 374. Survey of International Economic Issues. 3(1). Examination of current issues in the commercial relations among nations, including international trade, international finance, economic development, and the multinational enterprise. This course is designed for cadets who are not majoring in economics. Final exam or final project. Prereq: Econ 355 is strongly recommended. Sem hrs: 3 spring.

Econ 377. Financial Markets. 3(1). An introduction to and analysis of how the financial markets allocate personal and corporate resources in a modern capitalistic economy. Specific emphasis is placed 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. Final exam or project. Prereq: Econ 355 or department permission; Econ 333 and Econ 356 is recommended. Sem hrs: 3 fall.

Econ 391. Industrial Organization. 3(1). This course focuses on the structure and performance of markets and their regulation. It investigates the observed behavior of firms engaging in both legal and illegal marketplace competition. The course also examines the evolution of antitrust law in the United States and the impact these laws have on the market. Topics covered in the course include predatory pricing, price discrimination, bundling and tie-ins, tacit collusion, mergers and acquisitions. Final exam or final project. Prereq: Econ 333. Sem hrs: 3 spring.

Econ 411. Introduction to Game Theory. 3(1). This course will introduce the concepts required to analyze strategic situations, or situations in which a player's payoff depend on his choices and those of the other players. Topics will 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 will be especially important for those studying any of the social sciences. Final exam or final project. Prereq: Econ 333. Sem hrs: 3 spring

Econ 422. Labor Economics. 3(1). This course examines how people make decisions regarding their participation in the labor market. Included in this courses is the examination of government policies (such as social security, minimum wage, etc.) and their impacts of 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. Final exam or final paper. Prereq: Econ 332; Math 300 is recommended. Sem hrs: 3 spring.

Econ 450. International Economics. 3(1). Economic aspects of international relations, international trade, relationships among national currencies, international monetary systems, the balance of payments, and commercial policy. Final exam or final report. Prereq: Econ 355 or department permission; Econ 333; Econ 356 is recommended. Sem hrs: 3 fall.

Econ 454. Economics of Transition and Development. 3(1). This course 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. The course will focus on price liberalization, stabilization efforts, and the economic restructuring necessary to move a centrally planned economy to a market based economy. Additionally, the course will cover economic growth, population growth, income inequality, trade, and investment. Case studies from Eastern Europe, Latin and South America, Asia, and Africa may be included. Prereq: Econ 200; Econ 301 or Econ 355 recommended. Final exam or final project. Sem hrs; 3 spring.

Econ 457. Economies of Asia. 3(1). This course analyzes the major issues that define 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. Final Paper or Final Exam. Prereq: Econ 355 is strongly recommended. Sem hrs: 3 spring of even-numbered years.

Econ 459. Economics of Latin America. 3(1). 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. The course pays special attention to the prospects for further regional economic integration under NAFTA and other regional trade groups. Final exam or final paper. Prereq: Econ 355 is strongly recommended. Sem hrs: 3 spring.

Econ 465. Introduction to Econometrics. 3(1). Application of statistical tools to economic data, concentrating on methodology, econometric model building, and statistical inference. Final exam or final project. Prereq: Math 356 or Math 377. Sem hrs: 3 fall.

Econ 466. Forecasting and Model Building. 3(1). 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. This course is recommended for those cadets planning to pursue graduate study. Final exam, final project or final paper. Prereq: Econ 465. Sem hrs: 3 spring.

Econ 473. Public Finance. 3(1). Economics of the government sector, with emphasis on public goods, taxation, fiscal policy, and government regulation. Final exam or final report. Prereq:

Econ 333 or department permission. Sem hrs: 3 fall.

Econ 475. Money, Banking and Financial Institutions. 3(1). 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 is placed on financial events and policy issues. Final exam. Prereq: Econ 356 or department permission. Sem hrs: 3 spring.

Econ 478. Seminar in Defense Economics. 3(2). This course applies macroeconomics and microeconomics theory 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. The course will meet for two hours every other lesson. Final exam or final report. Prereq: Econ 333 or Mgt 423. C1C standing or department permission. Sem hrs: 3 spring.

Econ 495. Special Topics. 3(1). Selected topics in economics of either an advanced treatment or general interest orientation. Final exam or final report. Sem hrs: 3 fall or spring.

Econ 499. Independent Study. 3(0). Tutorial investigation of a specific area of economics. Final report. Sem hrs: 3 fall or spring.

- Econ 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Econ 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.

ELECTRICAL ENGINEERING (El Engr)

Offered by the Department of Electrical Engineering (DFEE)

El Engr 215. Electrical Signals and Systems. 3(1). An introduction to signal analysis and electronic system design. Topics include signal representation, signal analysis in the time and frequency domains, *digital systems*, basic circuit analysis, and realization of electronic functions used in the design and operation of Air Force instrumentation, communication, and digital signal processing systems. Lab. Final exam. Prereq: Math 142. Sem hrs: 3 fall or spring.

El Engr 231. Electrical Circuits and Systems I. 3(1). An 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. Lab. Final exam. Prereq: Math 142. Sem hrs: 3 fall or spring. El Engr 231 is a core alternate course for El Engr 215.

El Engr 281. Introductory Digital Systems. 3(1). An introduction to the fundamental principles of logic design. Topics include Boolean algebra, combinational and sequenctial logic networks with basic design and analysis techniques, *VHDL, FPGA*, and an introduction to digital processing systems. Laboratory projects include the design of digital systems and the analysis of computer architecture. Lab. Final exam. Sem hrs: 3 fall or spring.

El Engr 321. Electronics I. 3(2). An 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. Lab. Final exam. Prereq: El Engr 231. Sem hrs: 3 fall.

El Engr 322. Electronics II. 3(2). A continuation of El Engr 321 for El Engr 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. Lab. Final exam. Prereq: El Engr 321. Sem hrs: 3 spring.

El Engr 332. Electric Circuits and Systems II. 3(1). A 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. Final exam. Prereq: El Engr 231. Sem hrs: 3 fall.

El Engr 333. Continuous-Time Signals and Linear Systems. 3(1) An introduction to analog signal processing by linear, time-invariant systems. Topics include signal characterization, convolution, Fourier analysis methods, and state variable techniques. Final exam. Prereq: El Engr 332 and Math 346. Sem hrs: 3 spring.

El Engr 343. Electromagnetics. 3(1). The study of Maxwell's Equations, plane waves, transmission, and radiating systems. Topics include wave propagation, transmission lines, waveguides, and antennas. Lab. Final exam. Prereq: Physics 215 and Math 346, or department permission. Sem hrs: 3 spring.

El Engr 360. Instrumentation Systems. 3(1). 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. Lab. Final exam. Prereq: El Engr 215 or 231. Sem hrs: 3 spring.

El Engr 382. Microcomputer Programming. 3(1). Provides a broad-base understanding of microcontroller systems. The microcontroller principles presented provide a foundation that can be used in other courses to simplify (in some cases, substantially) projects. Includes design, application, interfacing, assembly language, and microcontroller hardware. Laboratory projects emphasize applications and interfacing. Lab. Final project. Final exam. Prereq: Comp Sci 110 and El Engr 281. Sem hrs: 3 fall.

El Engr 383. Microcomputer System Design I. 3(2). A 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. Lab. Final exam or final project. Prereq: El Engr 231, El Engr 281, El Engr 382. Sem hrs: 3 spring.

El Engr 387. Introduction to Robotic Systems. 3(1). Provides fundamental knowledge on robotic systems. The course topics include kinematics, dynamics, motion control, controller

design, and trajectory planning of robot manipulators. Cadets will also be introduced to basic computer vision techniques. Lab. Final project. Prereq: Math 245 or department permission. Sem hrs: 3 spring.

El Engr 434. Discrete-Time Signals and Systems. 3(1) An 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. Final exam. Prereq: El Engr 333. Sem hrs: 3 fall.

El Engr 444. Applied Field Theory. 3(1). Topics include antennas, fiber optics, scattering, Fourier optics, radiowave propagation, radar cross-section, and numerical methods. The analysis and design of practical systems is emphasized. A few lessons are reserved for current state-of-the-art topics, such as stealth technology, adaptive antennas, and holography. Lab. Final project. Prereq: El Engr 343 or department permission. Sem hrs: 3 fall.

El Engr 447. Communications Systems I. 3(1). An introduction to modern electrical communications. The performance of various modulation and detection methods for both analog and digital systems are analyzed. Coverage includes theory of operation, effects of random noise, bandwidth and other communication design constraints. Lab. Final exam. Prereq: El Engr 333 and Math 356; or Math 346, Math 356 and Engr 342. Sem hrs: 3 fall.

El Engr 448. Communications Systems II. 3(1). A follow-on course to El Engr 447 covering random processes and spectral analysis, optimal receivers, and performance of communication systems corrupted by noise. Advanced topics that vary from semester to semester include satellite communications, image processing, data communications, fiber optics, and wireless communications. Lab. Final exam or final project. Prereq: El Engr 447. Sem hrs: 3 spring.

El Engr 463. Capstone Design Project I. 3(2). 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. Final project. Prereq: El Engr 322, C1C standing, or department permission. Sem hrs: 3 fall.

El Engr 464. Capstone Design Project II. 3(2). Second course in the two-semester project design sequence for Electrical and Computer Engineering majors. Continues study of the system software and hardware lifecycle. Emphasis is placed on system design, appropriate implementation in hardware and software, analysis, testing and evaluation, quality assurance, and documentation. The course uses a design project to emphasize Air Force applications. Final project. Prereq: El Engr 463 or department permission. Sem hrs: 3 spring.

El Engr 472. Instrumentation System Fundamentals. 3(1) 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. Lab. Final exam. Prereq: El Engr 322. Sem hrs: 3 fall.

El Engr 473. Introduction to CMOS VLSI Circuit Design. 3(1). Introduction to design of Very Large Scale Integrated (VLSI) circuits in silicon Complementary Metal Oxide Semiconductor (CMOS) technology. Course includes discussion of the 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. Lab. Final project. Final exam. Prereq: El Engr 322 or department permission. Sem hrs: 3 fall.

El Engr 484. Microcomputer System Design II. 3(2). This course is the 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. Final project. Prereq: El Engr 383. Sem hrs: 3 fall.

El Engr 485. Computer Architecture. 3(1). This final course in the Computer Systems Area of Study quantitatively examines trade-offs 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 will examine state-of-the-art processors and computers. Lab. Final project. Prereq: Math 300, Math 356, or Math 377; and El Engr 382. Sem hrs: 3 spring.

El Engr 495. Special Topics. 1-3(1). Selected topics in electrical engineering. Typical subjects include audio power amplifier design, laser optics and weapons, advanced signal and image processing, and advanced electronics circuits. Final project. Prereq: Department permission. Sem hrs and offering time determined by department (not more than 3 sem hrs).

El Engr 499. Independent Study. 3(0). Individual study and research in an engineering design topic approved by the department head. Final paper and oral report. Prereq: Dept permission. Sem hrs: 3 fall or spring.

- El Engr 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- El Engr 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.

ENGINEERING (Engr)

Offered by various departments within the Engineering Divisions

Engr 100. Introduction to Engineering Systems 3(1). Introduces the USAFA engineering disciplines in the context of the engineering design process. Cadets will integrate these disciplines using a semester-long group design project. Cadets will employ modern computational tools to explore design alternatives and communicate their design solution. Administered by the Engineering Division with instructors from all engineering departments.

Final project. Sem hrs. 3 fall and spring.

Engr 311. Electrical Power Systems. 3(1). 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 phase and three phase AC power, single and three phase AC motors, transformers, transmission line modeling, AC to DC conversion, and DC motors. Final exam. Prereq: El Engr 231. (Administered by the Department of Electrical Engineering). Sem hrs: 3 fall or spring.

Engr 341. Linear Systems Analysis and Design. 3(1). 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. Lab. Final exam. Prereq: Math 245 and El Engr 231. (Administered by the Department of Astronautics). Sem hrs: 3 fall.

Engr 342. Linear Control System Analysis and Design. 3(2). 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. Final project. Prereq: Engr 341 or Mech Engr 325. (Administered by Department of Astronautics.) Sem hrs: 3 spring.

Engr 400. Divisional Seminar. 3(1). An 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. Term paper or final project. Prereq: First Class Honors Degree candidate or permission of the Division Chairman. (Administered by a selected engineering department). Sem hrs: 3 spring.

Engr 402. Professional Engineering Development. 0.5(1). Review of mathematics, chemistry, mechanics of materials, statics, dynamics, electrical circuits, thermodynamics, heat transfer, fluid mechanics, 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. Prereq: C1C standing; accredited engineering major. Pass/Fail. Sem hrs: 0.5 spring.

Engr 495. Special Topics in Engineering. 1-3(1). Selected topics in engineering, administered by various Engineering departments. Prereq: Permission of controlling department's head. Sem hrs: up to 3; offering times determined by controlling department.

ENGINEERING MECHANICS (Engr Mech)
Offered by the Department of Engineering Mechanics (DFEM)

Engr Mech 120. Fundamentals of Mechanics. 3(1). An introduction to the fundamental

principles of statics and mechanics of materials applied to aerospace systems. Topics include: force and moment equilibrium in three dimensions 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; failure modes of materials and structures; and application of systems engineering tools to the engineering design process. Laboratory exercises. Final exam. Prereq: Engr 100 and Math 141. Sem hrs: 3 fall or spring.

Engr Mech 320. Dynamics. 3(2). This course covers the analysis of kinematics and kinetic motions of particles and rigid bodies. Topics include kinematics with absolute and relative motions in Cartesian, path, and polar coordinates; and kinetics using force-mass-acceleration, work-energy, and impulse-momentum methods. Methods emphasize vector solutions. Laboratory exercises. Final Exam. Prereq: Engr Mech 120. Coreq: Math 245. Sem hrs: 3 fall or spring.

Engr Mech 330. Mechanics of Deformable Bodies. 3(1). Axial loading. Statically indeterminate structures. Beam theory: shear and moment diagrams, stress, and deflection. Transformation of stress and strain. Mohr's circle. Introduction to failure theories. Introduction to classical lamination theory. Euler buckling. Stress concentrations. Introduction to energy methods and Castigliano's theorems. Laboratory exercises. Final exam. Prereq: Engr Mech 120. Coreq: Math 245. Sem hrs: 3 fall or spring.

Engr Mech 332. Aerospace Structures. 3(1). Analysis and design of lightweight, thin-walled and semimonocoque structures. Margin of safety. Material selection including strength, stiffness and weight. Labs, final exam or final project. Prereq: Engr Mech 330. Coreq: Aero Engr 315 and Engr Mech 320. Sem hrs: 3 spring.

Engr Mech 340. Materials Science for Engineers. 3(l). Survey of 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. Field trip. Final exam. Prereq: Engr Mech 120. Sem hrs: 3 spring.

Engr Mech 350. Mechanical Behavior of Materials. 3(l). Behavior of materials under simple axial, biaxial and triaxial states of stress. Micromechanisms of elastic and inelastic deformation and strengthening mechanisms. Introduction to linear elastic fracture mechanics. Fatigue failure theories and fatigue crack growth analysis. Applications to design of aerospace vehicles and structures. Final exam. Prereq: Engr Mech 330. Sem hrs: 3 fall or spring.

Engr Mech 405. Engineering Seminar. 0(1). A seminar course designed to help transition DFEM majors from their undergraduate education to duties as an Air Force engineering officer and engineering professional. Seminar topics include current literature, engineering ethics and typical engineering problems that cadets may encounter after graduation. Invited speakers will offer their view of what it takes to be successful in the Air Force. The course normally meets once per week. Prereq: Open only to 1° Engineering Mechanics and Mechanical Engineering majors. Pass/fail. Sem hrs: 0 spring.

Engr Mech 42l. Vibrations. 3(l). Free and forced vibrations of discrete systems. Effect of viscous and other types of damping considered. Matrix methods used to analyze multi-degree-of-freedom systems. Dynamic analysis of continuous systems. Final exam or final project. Prereq: Engr Mech 320 or Physics 355; completed or enrolled in Math 346. Sem hrs: 3 spring.

Engr Mech 43l. Introduction to Finite Element Analysis. 3(l). Analysis and design of truss, frame, shell, and solid structures using the direct stiffness and energy formulation methods. Topics include: theoretical development of elementary finite elements and models, thermal and dynamic structural analysis, and computer-aided design and analysis projects using commercial, professional software. Final exam or final project. Prereq: Engr Mech 330, Math 346. Sem hrs: 3 fall or spring.

Engr Mech 432. Finite Element Analysis. 3(1). Analysis and design of complex structural components using the finite element method. Theoretical development of two-dimensional finite elements for static, vibration, and heat transfer analyses. Special topics in solving Laplace's equation. Computer-aided design and analysis projects using commercial finite element software. Field trip. Final exam or final project. Prereq: Engr Mech 431. Sem hrs: 3 spring.

Engr Mech 440. Physical Metallurgy. 3(2). Physical metallurgy related to properties of engineering metals. Study of crystal structure and imperfections, diffusion, thermodynamics, phases and phase transformations, and material processing and how each alters material properties. Discussion of specific metals/alloy systems and design philosophies for new alloys. Thermomechanical strengthening design project and semester-long knife design and construction project. Final project. Prereq: Engr Mech 340. Sem hrs: 3 fall.

Engr Mech 445. Failure Analysis and Prevention. 3(l). Failure analysis and prevention is a technical discipline that integrates mechanical engineering, materials engineering, and structural analysis into component analysis and design. Laboratory techniques including scanning electron microscopy, metallography, x-ray analysis, ultrasonic inspection, and mechanical testing will be used to determine the causes of failures of mechanical components. Re-designs may include changes in geometry, materials selection, or operation to preclude failure. Final exam or final project. Prereq: Engr Mech 350, Engr Mech 340 (recommended) and Engr Mech 440 (recommended). Sem hrs: 3 spring.

Engr Mech 450. Aerospace Composite Materials. 3(l). Introduction to select advanced aerospace materials. Topics covered include: mechanical behavior, design and analysis, processing, testing, inspection and repair of resin-matrix composite materials, and processing and application of metal-matrix and ceramic-matrix composites. Topics emphasized through hands-on project in design, fabrication, and testing of a composite structure. Final exam or final project. Field trip. Prereq: Engr Mech 330 and Math 245. Sem hrs: 3 fall.

Engr Mech 460. Experimental Mechanics. 3(2). Introduction to 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. Final report. Lab. Prereq: El Engr 231,

Engr Mech 320, Engr Mech 330, Math 300 or Math 356. Sem hrs: 3 fall.

Engr Mech 495. Special Topics. 3(l). Selected topics in mechanics. Final exam or final report. Prereq: Department permission. Sem hrs and offering time determined by the Department (not more than 3 sem hrs).

Engr Mech 499. Independent Study. 3(0). Individual study, research, or design on a topic established with the permission of the Department Head. Prereq: Departmental approval of USAFA Form 0-498 prior to enrollment. Final report. Sem hrs: 3 fall or spring.

- Engr Mech 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Engr Mech 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.
- Engr Mech 499C. Independent Study. 1(0). Sem hrs: 1 fall or spring.

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

English 109. Academic Communication for English as a Second Language Students. 3(1). 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. Prerequisite to English 111 for identified ESL students. ESL students receive validation credit for For Lang 131 and, after successful completion of English 109, they will receive validation credit for For Lang 132. Sem hrs: 3 fall.

English 110. Preparatory Composition. 3(1). Students will learn the basic conventions of academic writing that will prepare them for success in the core, especially English 111. The successful student will leave English 110 with the ability to develop college-level thinking and writing. Students will compose paragraphs and short essays with structural unity and stylistic clarity, respond to a literary text, use MLA documentation with competence, and write with basic grammatical/mechanical correctness. Prerequisite to English 111 for identified students. Prereq: None. Sem. Hrs: 3 fall.

English 111. Introductory Composition and Research. 3 (1). Emphasizes the fundamental uses of language, concentrating on sound academic writing and the rhetoric of argument. Introduces the student to basic methods and resources for academic research, and provides instruction and practice in the presentation, integration, and documentation of researched material. Establishes the foundation for analytical thinking through frequent writing assignments that derive from and reinforce a wide range of readings. Prereq: None. Sem hrs: 3 fall or spring.

English 211. Literature and Intermediate Composition. 3 (1). Refines the analytical and critical reading skills introduced in English 111 through the rhetorical examination of significant literary texts written by some of the world's greatest writers. Course objectives include acquiring skills in analytical and argumentative writing, research methods and applications, critical reading, and effective oral communication. Written assignments and oral presentations incorporate literary analysis and research, and provide a foundation for skills later honed in English 411. All fourth-class cadets who have validated or received transfer credit for English 111 should enroll in

English 211FR during their second semester. Cadets who have taken English 111 their fourth-class year should enroll in English 211 in their third-class year. Final exam. Prereq: English 111. Sem hrs: 3 fall or spring.

English 211FR. Literature and Intermediate Composition. 3 (1). Designed for students who have earned transfer or validation credit for English 111. See English 211 for course description. Additionally, the course introduces the student to basic methods and resources for academic research, and provides instruction and practice in the presentation, integration, and documentation of researched material. This course is not open to students who have taken English 111. Final exam. Sem hrs: 3 spring.

English 330. Communication in the Information Age. 3(1). Examines the writing and presentation skills essential for Air Force leaders in the information age. Considers how computers and hypertext affect communication and how today's leaders use and present technical information to accomplish the mission. Through labs, discussions, and workshops, students will develop the necessary skills to communicate effectively in cyberspace (via the Web and e-mail). Final project. Prereq: English 111. Sem hrs: 3 fall or spring.

English 34l. Literary Criticism. 3(l). 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. Final exam. Prereq: English 111. Sem hrs: 3 fall or spring.

English 353. Shakespeare. 3(1). Intensive study of Shakespeare's poetry and major plays within the cultural and historical perspectives of Renaissance England. Cadets attend a stage production of one play when available. Designed for cadets in any major. Final exam. Prereq: English 111. Sem hrs: 3 spring.

English 360. Classical Masterpieces. 3(l). A study of 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. Final exam or paper. Prereq: English 111. Sem hrs: 3 fall.

English 365. Television News: Production and Performance. 3(2). 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 the basic television production fundamentals and how to use the electronic technology to communicate to a mass audience. Prereq: English 111, completion of 4th class year and permission of the course director. Sem hrs: 3 fall or spring.

English 370. Speech Communication: Theory and Practice. 3(l). Considers selected topics in advanced speech communication through informative and persuasive speaking. Frequent

speaking assignments. Prereq: English 211. Sem hrs: 3 fall or spring.

English 380. Topics in Race, Gender, Class, and Culture. 3(1). Topics in literature, communication theory, linguistics, and rhetoric. The course explores issues relating to class, gender, and culture, including international and interdisciplinary topics. Emphasis will change 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. Final exam or final paper. Prereq: English 211. Sem hrs: 3 fall or spring.

English 383. Literature and Science. 3(l). Considers the interrelationships among science, technology, and literature--non-speculative 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. Prereq: English 211. Sem hrs: 3 fall.

English 395. Practicum in Writing Instruction. 3(1). A seminar course examining composition theory and applying that theory to tutorial writing instruction. Readings will include selections from texts such as *The St. Martin's Sourcebook for Writing Tutors, The Practical Tutor, Teaching One-to-One: The Writing Conference,* and *Dynamics of the Writing Conference: Social and Cognitive Interaction*. Class will include practice in tutoring as well as discussion of written responses to the theory and practice of writing instruction. Open to all majors. Prereq: English 211, C2C status, and instructor permission. Sem hrs: 3 fall.

English 411. Advanced Composition and Public Speaking. 3(1). Building on English 111 and English 211, this advanced course in communication gives students the rhetorical skills necessary for writing and speaking across the curriculum. Writing and speaking assignments will require doing research, analyzing the audience, and articulating a persuasive thesis. Topically, the course will focus on the literature of war and conflict. Prereq: English 211 or Humanities 200. Sem hrs: 3 fall or spring.

English 411FX (French Language Exchange Preparation). 3(1). Public Speaking and Advanced Composition. A tailored English 411 course offered only to primaries and alternates selected for the French Language Exchange. Topics for the course will be geared toward France and will help in preparing cadets for the exchange. The course will be followed by the French 492 preparatory course. Sem hrs: 3 summer.

English 411SX (Spanish Language Exchange Preparation). 3(1). Public Speaking and Advanced Composition. A tailored English 411 course offered only to primaries and alternates selected for the Spanish Language Exchanges. Topics for the course will be geared toward Spanish speaking countries and will help in preparing cadets for the exchange. Sem hrs: 3 summer.

English 461. British Literature I: Beginnings to Romanticism. 3(1). A survey of English poetry, drama, and prose of such authors as Chaucer, Spenser, Shakespeare, Milton, Pope, Swift, Fielding, and Johnson. Final exam. Prereq: English 111. Sem hrs: 3 fall.

English 462. British Literature II: Romanticism to the Present. 3(1). A survey of 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. Final exam. Prereq: English 111. English 461 recommended prior to 462. Sem hrs: 3 spring.

English 471. American Literature I: Beginnings to the Civil War. 3(1). A survey of American fiction, poetry, drama, and prose by such authors as Jefferson, Irving, Poe, Hawthorne, Melville, Whitman, Bradstreet, Wheatley, Dickinson, and Douglass. Final exam. Prereq: English 111. Sem hrs: 3 fall.

English 472. American Literature II: Reconstruction to the Present. 3(1). A continuation of the survey of American fiction, poetry, drama, and prose by such writers as Robinson, Eliot, Frost, O'Neill, Fitzgerald, Faulkner, Hemingway, Wright, Twain, Morrison and selected contemporary authors. Final exam. Prereq: English 111. English 471 recommended prior to 472. Sem hrs: 3 spring.

English 475. Creative Writing. 3(l). 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. Final project. Prereq: C2C or C1C standing. Sem hrs: 3 fall or spring.

English 484. Literature of War. 3(1). 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). Final exam. Prereq: English 211. Sem hrs: 3 spring.

English 485. Contemporary Literature. 3(1). A study of literature written within the last twenty years--within the lifetimes of students enrolled in the course. Several genres will be offered, depending upon the semester, and will change for each offering. Emphasis will be on American and British literature, but other cultures, such as Russian, Central American, and Third World, may also be represented. Examples of contemporary writers whose works might be included are Sam Shepard, August Wilson, Marsha Norman, David Mamet, William Carpenter, Stephen Dobyns, Ann Beattie, Toni Morrison, Richard Ford, John Updike and Jay McInerney. Cadets will study at least three genres (for example: novels, short fiction, and poetry; or plays, essays, and criticism). Final exam or paper. Seminar approach. Prereq: English 211. Sem hrs: 3 spring.

English 490. First Class Seminar. 3(l). An 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. Final paper. Prereq: English 34l and C1C standing or permission of Department Head. Sem hrs: 3 fall or spring.

English 495. Special topics. 3(1). Selected topics in English. Previous topics have included Afro-American Literature, Literature by Women, Detective Fiction, Science Fiction and The Roots of Fantasy, Film Studies, Introduction to Linguistics, and Myth and the Hero. Final exam or paper. Prereq: English 111. Sem hrs: 3 fall or spring.

English 499. Independent Study. 3(0). 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. Final report. Prereq: department permission. Sem hrs: 3 fall or spring.

- English 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- English 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.

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

Fine Art 375. Introduction to Film Studies. 3(1). A structured introduction to cinema. Course will take a thematic or chronological approach to the study of film as art form, with attention to film-making techniques, narration, forms of genre, and modes of production. Final paper or project. Prereq: English 111. Sem hrs: 3 fall or spring.

Fine Art 452. Art in History. 3(1). A chronological historical survey of art from antiquity to the present. Includes study of the major periods, schools, and styles of art, and biographies of important artists. Hands-on exercises will reinforce student's understanding of course material. This course is interdisciplinary; discussion will include music, drama, and dance as necessary to provide students with historical/social and political contexts of art masterpieces. Text and class lectures will be augmented with slides, videotapes, music selections, guest artists and lecturers, and actual art objects. Final exam or final project. Prereq: None. Sem hrs: 3 fall.

Fine Art 458. Music Appreciation. 3(1). Survey of music of the Western world and a study of basic elements, forms, and styles in representative works by major composers. Emphasis on listening, understanding, and appreciation. Voluntary field trip to an area concert during cadet activity time. Knowledge or talent in music is not required. Final exam or final project. Prereq: None. Sem hrs: 3 fall or spring.

Fine Art 459. Introduction to Drawing and Design. 3(1) This course is the first course for students with no practical studio experience in drawing and design composition. Course assignments will include hands-on class exercises and homework projects. Students will learn to apply the principles of design to common design tasks. They will gain practical experience in sketching and using gesture and contour modes of drawing. Final project. Prereq: None. Sem hrs: 3 spring.

Fine Art 461. Advanced Studio Art. 3(1). A studio course for students who have previous art studio experience. Students plan and execute projects which provide more artistic and technical challenges than Fine Art 463 or Fine Art 464. Final project. Prereq: Fine Art 463, Fine Art 464, or instructor permission. Sem hrs: 3 fall or spring.

Fine Art 463. 3-D Studio Art: Clay and Sculpture. 3(2). An introductory course to practical 3-D processes in art. Students will work with coil, slab, hand-built, and wheel-thrown pottery. They will plan and create clay, wire, assemblage, and carved sculptural projects in relief and in-the-round. Students will make preparatory sketches for their projects. Final project. Prereq: None. Sem hrs: 3 fall.

Fine Art 464. 2-D Studio Art: Painting and Printmaking. 3(2). A course in practical 2-D processes in art. Students will learn figure drawing, watercolor, and acrylic painting and complete several projects in each medium. They will also complete several projects in printmaking: relief, etching, monoprint, or collograph. Final project. Prereq: Fine Art 459; or previous drawing experience with instructor approval. Sem hrs: 3 spring.

Fine Art 477. Fine Arts in the USA. 3(1). This course offers an interdisciplinary approach to the arts in the United States with emphasis on the United States. A chronological approach to the content will explore common themes in the arts by studying archeology, painting, sculpture, and music. Students can expect to experience the arts through slides, musical selections, guest artist, film, videotapes, and other media. Final project. Sem hrs: 3 fall.

Fine Art 495. Special Topics. 3(1). Selected special topics in Fine Arts. Final exam or final report. Sem hrs: 3 fall or spring.

Fine Art 499. Independent Study. 3(0). Independent study in art or music. Subject and meetings arranged with the instructor. Prereq: For visual art, one of the visual arts courses and department approval; for music, Fine Art 458 and instructor permission. Sem hrs: 3 fall or spring.

- Fine Art 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Fine Art 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.

FOREIGN AREA STUDIES (For Ar Stu)

Offered by the Department of Economics and Geography (DFEG), the Department of Foreign Languages (DFF), the Department of History (DFH), and the Department of Political Sciences (DFPS)

For Ar Stu 400. Summer Foreign Language Immersion. 3(1). Intensive foreign language and culture study at an accredited foreign university or language institute. Pass/fail. Cadets must take the Defense Foreign Language Proficiency Test (DLPT) prior to departure and within sixty days after program completion to earn a "P" grade. Prereq: For Lang 321, equivalent advanced placement, or completion of For Lang 222 for Arabic, Chinese, Japanese, and Russian; Foreign Area Studies Steering Group (inter-departmental) permission. Sem hrs: 3 summer.

For Ar Stu 410. Model Arab League (MAL). 3(1). Inter-departmental, inter-disciplinary 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, socio-economic, 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. Final project or paper. Prereq: C1C or C2C standing, course director's permission. Sem hrs: 3 spring.

For Ar Stu 415. Advanced Model Arab League (AMAL). 3(1). Advanced Inter-departmental, inter-disciplinary 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, socio-economic, 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. Final paper. Prereq: C1C standing, successful completion of For Ar Stu 410, and course director's permission. Sem hrs: 3 spring.

For Ar Stu 420. Model Organization of American States (MOAS). 3(1). Inter-departmental, inter-disciplinary 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, socio-economic, 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. Final project or paper. Prereq: C1C or C2C standing, course director's permission. Sem hrs: 3 spring.

For Ar Stu 425. Advanced Model Organization of American States (AMOAS). 3(1). Advanced inter-departmental, inter-disciplinary seminar on contemporary issues on Latin America, preparing students for regional or national-level competitions of the MOAS. Specialists from various departments introduce historical, geographical, political, socio-economic, 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. Final paper. Prereq: C1C standing, successful completion of For Ar Stu 420, course director's permission. Sem hrs: 3 spring.

For Ar Stu 430. Model African Union (MAU). 3(1). Inter-departmental, inter-disciplinary seminar on contemporary issues in Africa, preparing Foreign Area Studies majors for regional or national-level competitions of the MOAU. Specialists from various departments introduce historical, geographical, political, socio-economic, 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. Final project or paper. Prereq: C1C or C2C standing, course director's permission. Sem hrs: 3 spring.

For Ar Stu 435. Advanced Model African Union (AMAU). 3(1). Advanced Inter-departmental, inter-disciplinary seminar on contemporary issues on Africa, preparing students for regional or national-level competitions of the MOAU. Specialists from various departments introduce

historical, geographical, political, socio-economic, 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. Final paper. Prereq: C1C standing, successful completion of For Ar Stu 430, course director's permission. Sem hrs: 3 spring.

Foreign Area Studies 440. Model European Organizations. 3(1) Interdepartmental, interdisciplinary seminar on contemporary issues in Europe. This course prepares cadets for regional or national-level competitions of the Model NATO and/or Model EU. Specialists from various departments introduce historical, geographical, political, socio-economic, 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. Final Exam, Project, or Paper. Prereq: C1C or C2C standing, course director's permission. Sem hrs: 3 fall or spring.

For Ar Stu 445. Advanced Model North Atlantic Treaty Organization (AMNATO). 3(1). Advanced Inter-departmental, inter-disciplinary 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, socio-economic, 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. Final paper. Prereq: C1C standing, successful completion of For Ar Stu 440, course director's permission. Sem hrs: 3 spring.

For Ar Stu 470. France in the 20th Century. 3(1). Inter-disciplinary course taught primarily in French, designed to give For Ar Stu majors with a focus on West European and French language studies a better understanding of 20th century France. It will combine expertise from the Foreign Language, Political Science, Geography, 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. Final exam. Prereq: French 321. Sem hrs: 3 spring.

For Ar Stu 495. Special Topics in Foreign Area Studies. 3(1). Inter-disciplinary course designed to serve as a capstone or special experience for Foreign Area Studies majors. (The following suffixes indicating geo-cultural region of course specialization apply: "A" for Asia, "E" for Eastern Europe, "F" for Africa, "L" for Latin America, "M" for the Middle East, "S" for Russia or Slavic regions, and "W" for 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. Final paper or final exam. Prereq: C1C or C2C standing, course director's permission. Sem hrs: 3 fall or spring.

FOREIGN LANGUAGES (For Lang)

Offered by the Department of Foreign Languages (DFF)

Supplemental Information:
All cadets who have a background in one of the foreign languages offered at the Academy will be administered a placement examination. Prospective cadets will take the French, German, and Spanish exams on-line prior to arrival at USAFA. Cadets testing in other languages will take their test upon arrival at the Academy. Based on the results of their examination, cadets will be placed into an appropriate course and level.

Foreign Language Placement:
Cadets without prior language background and cadets who score low on a placement examination will be placed into For Lang 131 (Basic Sequence), normally in the language of their choice. Cadets with one or two years of previous study of the language will normally be placed into For Lang 141 (Accelerated Basic Sequence); all 100 level foreign language courses (131, 132, 141, 142) will meet every day for 50 minutes. Cadets who place into the 200 level or higher will retroactively receive validation credit for For Lang 131-132 after completing the language courses required by their major.

Language	**Typical Four Semester Course Sequence**				
French					
German					
Arabic					
Chinese	131	132	221	222	
Japanese					
Russian					
French					
German	141	142	skip	222	223
Spanish					

For Lang 131-132. (Basic Sequence). 3-3(2'-2').

Arabic	131-132	Basic Arabic
Chinese	131-132	Basic Chinese
Japanese	131-132	Basic Japanese
Russian	131-132	Basic Russian
German	131-132	Basic German
Spanish	131-132	Basic Spanish (currently not being offered)
French	131-132	Basic French

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. Final exam both semesters. Must be taken sequentially. Sem hrs: For Lang 131 - 3 fall; For Lang 132 - 3 spring. Cadets who successfully complete For Lang 132 will enroll next in For Lang 221.

For Lang 141-142. (Accelerated Basic Sequence). 3-3(2'-2').

French	141-142	Accelerated Basic French
German	141-142	Accelerated Basic German

Spanish	141-142	Accelerated Basic Spanish

Accelerated basic foreign language study. Foundational Language, Culture, and Civilization. Language Learning Center supplements classroom instruction. Students are placed in the course on the basis of placement examination scores. Final exam both semesters. Must be taken sequentially. Sem hrs: For Lang 141 - 3 fall; For Lang 142 - 3 spring. Cadets who successfully complete For Lang 142 will enroll next in For Lang 222.

For Lang 221. 3(1).

Arabic	221	Intermediate Arabic I	(Fall)
Chinese	221	Intermediate Chinese I	(Fall)
French	221	Intermediate French I	(Fall)
German	221	Intermediate German I	(Fall)
Japanese	221	Intermediate Japanese I	(Fall)
Russian	221	Intermediate Russian I	(Fall)
Spanish	221	Intermediate Spanish I	(currently not being offered)

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. Language Learning Center may supplement classroom instruction. Final exam. Prereq: Normally for students who have taken For Lang 131-132 in Chinese, Arabic, Japanese, and Russian. For French, and German: successful completion of For Lang 131/132 or placement into this level. Sem hrs: 3 fall.

For Lang 222. 3(1).

Arabic	222	Intermediate Arabic II	(Spring)
Chinese	222	Intermediate Chinese II	(Spring)
French	222	Intermediate French II	(Fall and Spring)
German	222	Intermediate German II	(Fall and Spring)
Japanese	222	Intermediate Japanese II	(Spring)
Russian	222	Intermediate Russian II	(Spring)
Spanish	222	Intermediate Spanish II	(Fall)

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. Language Learning Center may supplement classroom instruction. Final exam. Prereq: Successful completion of For Lang 142, or For Lang 221 (Arabic, Chinese, Japanese, Russian), or placement into this level. Sem hrs: 3.

For Lang 223. 3(1).

Arabic	223	Intermediate Arabic III	(Fall)
Chinese	223	Intermediate Chinese III	(Fall)
French	223	Intermediate French III	(Fall and Spring)
German	223	Intermediate German III	(Fall and Spring)
Japanese	223	Intermediate Japanese III	(Fall)
Russian	223	Intermediate Russian III	(Fall)
Spanish	223	Intermediate Spanish III	(Fall and Spring)

Focus on conversational practice and aural comprehension of contemporary spoken language,

with increased attention to reading. Final exam. Prereq: Successful completion of For Lang 222 or placement into this level. Sem hrs: 3.

For Lang 321. 3(1).

Arabic	321	Advanced Arabic	(Spring)
Chinese	321	Advanced Chinse	(Spring)
French	321	Advanced French	(Fall and Spring)
German	321	Advanced German	(Fall and Spring)
Japanese	321	Advanced Japanese	(Spring)
Russian	321	Advanced Russian	(Spring)
Spanish	321	Advanced Spanish	(Fall and Spring)

A capstone communication course designed to enhance the students' ability in the language and culture. Final exam. Prereq: For Lang 223 or placement into this level. Sem hrs: 3.

For Lang 365. 3(1).

Arabic	365	Arabic Civilization and Culture	(Fall of odd-numbered years)
Chinese	365	Chinese Civilization and Culture	(Fall of odd-numbered years)
French	365	French Civilization and Culture	(Fall and Spring)
German	365	German Civilization and Culture	(Fall and Spring)
Japanese	365	Japanese Civilization and Culture	(Fall)
Russian	365	Russian Civilization and Culture	(Fall)
Spanish	365	Spanish Civilization and Culture	(Fall and Spring)

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. Final exam. Prereq: Successful completion of For Lang 321 or department permission. Sem hrs: 3.

German 370. Three Hundred Years of German Immigration to America. 3(1). 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, we will study 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. Final exam. Prereq: German 321 or placement into 300 level. Sem hrs: 3 fall.

Spanish 371. Current Events in the Spanish-Speaking World. 3(1). Cadets will experience a semester-long survey of significant current events in the Spanish-speaking world. They will 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, and emphasis is placed in oral discussions and written production. All the activities in the class are conducted in Spanish. Final exam or final project. Prereq: Spanish 321 or placement into 300 level. Sem hrs: 3 fall or spring.

French 372. Francophone Cultures. 3(1). Course 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, cadets will cooperatively research and discuss various French-speaking countries. Francophone Africa will figure prominently. Focus will be 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. Final exam. Prereq: French 321 or placement into 300 level. Sem hrs: 3 fall.

Japanese 372. Japanese Society and Culture. 3(1). 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. Discussion 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. The class will be team taught with an exchange officer from the Japan Air Self Defense Force. All activities are conducted in Japanese. Final exam. Prereq: Japanese 321 or placement into this level. Sem hrs 3 spring of odd-numbered years.

For Lang 376. 3(1).

Arabic	376	Introduction to Literature	(Spring of even-numbered years)
Chinese	376	Introduction to Literature	(Spring of even-numbered years)
French	376	Introduction to Literature	(Spring only as needed)
German	376	Introduction to Literature	(Spring only as needed)
Japanese	376	Introduction to Literature	(Fall of odd-numbered years)
Spanish	376	Introduction to Literature	(Fall)
Russian	376	Introduction to Literature	(Spring only as needed)

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. Final exam. Prereq: For Lang 321. Sem hrs: 3.

Spanish 377. Introduction to Literature of Latin America. 3(1). Primary focus is a survey of important Latin American writers, their works, and influences on their societies. Students are provided cultural insights through literature. Discssions are conducted in the target language and based on selected literary works ranging from early times to contemporary periods. All classes will be conducted in the target language. All assignements will be conducted in the target language. Final exam. Prereq: For Lang 321. Sem hrs: 3 spring.

For Lang 491. 3(1).

Arabic	491	Arabic Advanced Readings	(Fall of even-numbered years)
Chinese	491	Chinese Advanced Readings	(Fall of even-numbered years)
French	491	French Advanced Readings	(Fall as needed)
German	491	German Advanced Readings	(Fall)
Japanese	491	Japanese Advanced Readings	(Spring of odd-numbered years)
Russian	491	Russian Advanced Readings	(Fall of even-numbered years)
Spanish	491	Spanish Advanced Readings	(Spring)

Language program with primary emphasis on the development of advanced foreign language reading skills via a variety of media. All classes will be conducted in the target language. All assignments will be completed in the target language. Final exam. Prereq: For Lang 321 or department permission. Sem hrs: 3 fall or spring.

French 492. French AFA Preparation. 1(0). 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 will be conducted in French. Pass/fail. Final exam. Prereq: French 321 or placement into 300-level and approval by the Superintendent for participation in the French Air Force Academy or Canadian Royal Military Academy Exchange Programs. Sem hrs: 1 spring.

German 492. German AFA Preparation. 1(0). 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 will be conducted in the target language. All assignments will be completed in the target language. Pass/fail. Prereq: German 321 or placement into 300-level and approval by the Superintendent for participation in the German Air Force Academy Exchange Program. Sem hrs: 1 spring.

Japanese 492. Japanese AFA Preparation. 1(0). 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 will be conducted in the target language. All assignments will be completed in the target language. Pass/fail. Prereq: Japanese 321 or placement into 300-level and approval by the Superintendent for participation in the Japanese Air Force Academy Exchange Program. Sem hrs: 1 (not currently offered).

Spanish 492A. Spanish AFA Preparation. 1(0). 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 will be conducted in the target language. All assignments will be completed in the target language. Pass/fail. Prereq: Spanish 321 or placement into 300-level and approval by the Superintendent for participation in the Spanish Air Force Academy Exchange Program. Sem hrs: 1 spring.

Spanish 492B. Chilean AFA Preparation. 1(0). 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 will be conducted in the target language. All assignments will be completed in the target language. Pass/fail. Prereq: Spanish 321 or placement into 300-level and approval by the Superintendent for participation in the Chilean Air Force Academy Exchange Program. Sem hrs: 1 spring.

For Lang 495. Special Topics. 1-3(1). Selected topics in foreign languages. Final exam or final report. Prereq: Department permission. Sem hrs and offering time determined by Division Chief. Sem hrs: 1-3.

For Lang 499. Independent Study. 3(0). Individual study or research conducted on a tutorial basis. Study may be in any of the seven languages offered by the department. Topic or area of

study/research must be approved by the department head. Final exam and/or term paper. Prereq: DFF permission. Sem hrs: 3 fall or spring.

- For Lang 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- For Lang 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.

GEOGRAPHY (Geog)

Offered by the Department of Economics and Geography (DFEG)

Geog 310. Geospatial Information Analysis. 3(1). This course prepares cadets with the basic tools necessary to make decisions with geographic (geospatial) information. The course introduces data sources and collection techniques (e.g. use of remote sensing and GPS). Cadets will 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 cadets will complete projects to demonstrate the ability to solve an ill-defined spatial problem and make recommendations to a decision maker. Final exam or final project. Prereq: Physics 215. Sem hrs: 3 fall or spring.

Geog 350. Human Geography. 3(1). This course is designed to acquaint cadets with geography in general and its human aspects in particular. Cadets will 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. Final exam. Prereq: None. Sem hrs: 3 spring.

Geog 351. Introduction to Physical Geography. 3(1). The 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. Final exam or final research project. Prereq: None. Sem hrs: 3 fall.

Geog 353. Geomorphology. 3(1). An analysis of the dynamic processes, distribution, and structure of the earth's physical features. Focuses on fundamental concepts of physical geology, climate, soils, and vegetation. Final exam or final project. Prereq: None. Sem hrs: 3 spring of odd-numbered years.

Geog 355. Field Methods in Geography. 3(1). Students learn design and execution of geographic field research. Phase I of the course is classroom instruction on the physical, environment, cultural, and geological aspects of a study site and instruction on specific tools to be used in a field of study. Phase II consists of a week-long field laboratory where students apply their skills in the natural environment. Phase III returns to the classroom where cadets learn various methods of analysis and discuss results. Final exam. Prereq: Department approval. Sem hrs: 3 summer.

Geog 360. Environmental Geography. 3(1). 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. Final project or final exam. Prereq: None. Sem hrs: 3 spring of even-numbered years.

Geog 370. Military Geography. 3(1). 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. Final exam or final research project. Prereq: None. Sem hrs: 3 fall.

Geog 382. Remote Sensing and Imagery Analysis. 3(1). Introduction to photogrammetry using both vertical and oblique imagery. 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 spaceborne sensing systems. Final exam or final project. Prereq: Geog 310. Sem hrs: 3 spring.

Geog 410. Advanced Geospatial Information Analysis. 3(1). This course builds on the techniques and concepts learned in Geospatial Information Analysis (Geog 310). Topics covered include more advanced discussions on spatial interpolation, error and uncertainty, Global Positioning Systems (GPS), and multi-objective decision making. Emphasis is on advanced analytical techniques including vector and raster data modeling and data systems used to solve Air Force spatial problems. The course provides project design strategies to meet changing needs of the global battle space. Final exam or final project. Prereq: Geog 310. Sem hrs: 3 fall.

Geog 442. Seminar on Geographic Thought and Research Methods. 3(1) Examines the evolution of geographic thought and the impact of modern technologies on the nature of the discipline. Cadets will complete an outline for a substantive research paper on a topic of their choice. Library and/or Field research required. Final project or final exam. Prereq: Geog or ForArStu major or department permission. Sem hrs: 3 fall.

Geog 470. Geography of Europe and Russia. 3(1). 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. Final exam or final project. Prereq: None. Sem hrs: 3 spring of odd-numbered years.

Geog 471. Geography of the Americas. 3(1). 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. Final exam or final project. Prereq: None. Sem hrs: 3 fall of odd-numbered years.

Geog 475. Geography of Asia. 3(1). Geographic 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. Final exam or final project. Prereq: None. Sem hrs: 3 fall of even-numbered years.

Geog 480. Geography of the Middle East and Africa. 3(1). 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. Final exam or final project. Prereq: None. Sem hrs: 3 spring of even-numbered years.

Geog 495. Special Topics. 3(1). Selected topics in geography. Final project, final exam, or research paper. Prereq: None. Sem hrs: 3 fall or spring.

Geog 498. Geographic Interpretation, Analysis, and Integration. 3(2). Capstone course in geography. Using field experiences and case studies, the course is designed to assess the student's ability to integrate and synthesize geoscience knowledge, analytical techniques, and research methods in geography and cognate disciplines as they apply to the support of the battle space. Final project. Prereq: C1C standing. Sem hrs: 3 spring.

Geog 499. Independent Study. 3(0). Independent research under the direction of a faculty member. Research paper or final project. Prereq: Department permission. Sem hrs: 3 fall or spring.

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

History 101. Modern World History. 3(1). A survey of the major pre-modern civilizations and the development and diffusion of modern culture throughout the world, focusing primarily on world civilizations from 1500. This course examines the interaction of traditional and modern cultures culminating with the turbulent twentieth century. The clashes of major ideologies are seen on a global scale, including the role of the United States in the twentieth century. Course must be taken during the fourth-class year. Written assignments and final exam. Prereq: None. Sem hrs: 3 fall or spring.

History 202. Introduction to Military History. 3(1). Survey of 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 United States. Emphasizes how political, social, economic, and technological factors have combined to shape various changes and continuities in the nature of Western warfare. Written assignments and final exam. Prereq: History 101. Sem hrs: 3 fall or spring.

History 320. History of Technology and Warfare. 3(1). 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. Special treatment is afforded to the impact of engineering and the industrial revolution on the development of technology and the subsequent impact on warfare. The interrelationship of technology, tactics, and strategy provides the thematic framework. Several lessons are devoted

to case studies of battles and campaigns that illustrate significant developments. Term paper and final exam. Prereq: History 202. Sem hrs: 3 spring.

History 325. History of Christianity. 3(1). A historical survey of the Christian church from its ancient Jewish roots to the modern period. The course will examine 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. Term paper and final exam. Prereq: History 101. Sem hrs: 3 spring of odd-numbered years.

History 330. Historiography and Methodology. 3(1). 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. Final paper. Prereq: Histroy 202 or department permission. Sem hrs: 3 fall or spring.

History 332. History of U.S. Foreign Policy. 3(1). Examines major developments in U.S. foreign policy from colonial times to the present, with particular emphasis on the twentieth century. The course will focus on the motives behind the conceptualization of diplomatic goals, the search for appropriate tactics to achieve policy objectives, and the consequences of U.S. foreign policy at home and abroad. Coursework centers on classroom lecture and discussion, and extensive analysis of interpretive essays and primary documents. Term paper and final exam. Prereq: History 101. Sem hrs: 3 spring of odd-numbered years.

History 335. History of the American West. 3(1). A study of 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. This course will explore the validity of Frederick Jackson Turner's frontier thesis and the events that made the West unique. Term paper and final exam. Prereq: History 101. Sem hrs: 3 fall of even-numbered years.

History 336. History of the American South. 3(1). Examines the special contributions of the South to the evolution of the United States, and analyzes the major themes of Southern history in the eighteenth, nineteenth, and twentieth centuries. Emphasis will be placed on understanding ideas and values, especially as the people of the South have perceived them, and their role in Southern society. This course will focus on how Southern society evolved differently from the rest of the United States, and seemingly over a century and a half merged with mainstream America while maintaining a unique identity. Term paper and final exam. Prereq: History 101. Sem hrs: 3 fall of odd-numbered years.

History 338. Colonial Warfare. 3(1). A comprehensive examination of the competition and conflicts that resulted from European explorations and conquests of the fifteenth, sixteenth, and

seventeenth centuries that erupted into serial warfare in the eighteenth century. These conflicts exposed all sides to different modes of warfare that would shape future combat. This course 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. Term paper and final exam. Prereq: History 202. Sem hrs: 3 fall of even-numbered years.

History 339. The American Civil War. 3(1). A multidimensional examination of the causes, conduct, and legacy of the American Civil War. An in-depth analysis of Southern sectionalism will precede a comprehensive discussion of all aspects of the war itself: military, economic, cultural, social, political, technological and ideological. The course will conclude by describing the short and long-term effects of the war on the American military establishment. Term paper and final exam. Prereq: History 202. Semester hrs: 3 fall.

History 340. History of Colonial Latin America. 3(1). 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. Students will examine 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. Term paper and final exam. Prereq: History 101. Sem hrs: 3 fall.

History 341. History of Modern Latin America. 3(1). 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 nineteenth century. Treats major issues of the twentieth century, including political change, industrialization, foreign influence, military institutions, social and demographic pressures, and the United States's role in different national contexts. Term paper and final exam. Prereq: History 101. Sem hrs: 3 spring.

History 342. History of Traditional Asia. 3(1). A survey of the major political, economic, and socio-cultural developments in Asia (primarily China, Japan, India, and Southeast Asia) from prehistoric times to the arrival of the Europeans in the sixteenth 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. Term paper and final exam. Prereq: History 101. Sem hrs: 3 fall.

History 343. History of Modern Asia. 3(1). A survey of the major political, economic, and socio-cultural developments in Asia (primarily China, Japan, India, and Southeast Asia) from roughly the sixteenth 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. Term paper and final exam. Prereq: History 101. Sem hrs: 3 spring.

History 344. Foundations of European History. 3(1). How did the European continent rise from being a cultural and intellectual backwater to become a political and military powerhouse which

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. Major aspects of European development are analyzed, 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. Term paper and final exam. Prereq: History 101. Sem hrs: 3 fall.

History 345. Modern European History. 3(1). A survey of 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. This course concludes with a study of the legacies of the Cold War and the advent of the European Union. Term paper and final exam. Prereq: History 101. Sem hrs: 3 spring.

History 346. History of Russia. 3(1). Survey of Russian domestic and foreign affairs from the ninth century to 1861. Emphasis on the ways in which Eastern, Western, and native influences promoted continuity within the Tsarist Russian state, to include: autocracy, church-state relations, imperialism, great power status, foreign power intervention, and modernization. Term paper and final exam. Prereq: History 101. Sem hrs: 3 fall.

History 347. History of Modern Russia. 3(1). Survey of domestic and foreign affairs from 1861 to the present. Focuses on the dynamics of Russian society and government from the Great Reforms through the Bolshevik seizure of power. Reviews Communist attempts and the final failure to develop a legitimate Soviet state. Gives special attention to the unique synthesis of military and economic power leading to "superpower" status and its eventual demise. Term paper and final exam. Prereq: History 101. Prior completion of History 346 is recommended but not required. Sem hrs: 3 spring.

History 351. The Foundations of Modern America. 3(1). Examines the political, intellectual, social, and economic origins and development of the United States from the first settlements through the Reconstruction period (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. Term paper and final exam. Sem hrs: 3 fall or spring.

History 352. The History of Modern America. 3(1). Continues the examination of the political, intellectual, social, and economic development of the United States from the late nineteenth century to the present. Concentrates on the growth of the United States as a major economic and political power. Special attention is given to the impact of industrialization, urbanization, immigration, reform movements, mass culture, domestic economic fluctuations, governmental expansion, and military involvements during the twentieth century. Term paper and final exam. Sem hrs: 3 fall or spring.

History 363. Unconventional Warfare. 3(1). 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. Term paper and final exam. Prereq: History 202. Sem hrs: 3 fall.

History 367. Ancient, Medieval and Early Modern Warfare. 3(1). 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. Term paper and final exam. Prereq: History 202. Sem hrs: 3 fall of even-numbered years.

History 368. World War II. 3(1). A study of the largest conflict in human history, including a detailed analysis of the causes, ideologies, strategies, technologies, and campaigns of the war. Students will also examine 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. Term paper and final exam. Prereq: History 202. Sem hrs: 3 spring.

History 369. Limited War in the Twentieth Century: Korea and Vietnam. 3(1). 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 United States tried to fight wars that would achieve limited aims with limited means. This course will examine the Korean and Vietnam Wars as part of larger patterns of contemporary history. Studies will place special emphasis on the role of technology, foreign policy, domestic social and political climates, and the long-term implications of American strategy and policymaking. Term paper and final exam. Prereq: History 202. Sem hrs: 3 spring of even-numbered years.

History 370. World War I. 3(1). A detailed analysis of the epochal event of the twentieth century. Students explore the role of ideology, military and social doctrine, alliance systems, and European militarism on the outbreak and conduct of total war in Europe. Detailed analysis of the disparate military environments of stalemate on the Western Front, deadlock on the high seas and maneuver warfare on the Eastern Front will illustrate the struggle between military doctrine and emerging technology. Special emphasis will be placed on the integration of air power and the emergence of modern paradigms for conducting warfare. Term paper and final exam. Prereq: History 202. Sem hrs: 3 fall of even-numbered years.

History 371. Airpower and Modern Warfare. 3(1). History of the air weapon with primary emphasis on leadership and tactics as they evolved during the twentieth century. Covers global development of military airpower, stressing the constant interplay among personalities, institutions, theories, technology, combat experience, and evolving doctrine. Term paper and final exam. Prereq: History 202. Sem hrs: 3 fall.

History 372. Sea Power and Modern Warfare. 3(1). History of sea weapons with primary emphasis on technology, tactics, and leadership as they have evolved from 1000 BC to the present. World-wide treatment stresses the constant interplay among personalities, institutions, theories, technology, combat experience, and the evolving doctrine. Final exam. Prereq: History 202. Sem hrs: 3 spring of even-numbered years.

History 373. History of Sub-Saharan Africa. 3(1). Survey course examining important roles the peoples of Africa played in the unfolding story of humankind, and why the continent was ignored by Western Europeans for so long before being suddenly attacked in a "frenzy" of imperial conquests. Explores how Africans coped with the radical changes to their political, economic, and social institutions in the nineteenth century and the theories behind the origins of Africans civilizations. Examines the extensive Berber trading networks of North Africa; compares the Swahili city-states of East Africa with those of ancient Greece, and looks at why the Kingdom of Dahomey built its wealth and power in the African slave trade. Students study how Africa's past influenced its response to colonial rule and how Africans threw off colonial domination in the twentieth century. Also introduces students to modern-day problems of environmental degradation, population growth, debt crisis, security issues and medical challenges in Africa. Uses primary documents on Africa and a rich abundance of historical novels written by African authors. Term paper and final exam. Prereq: History 101. Sem hrs: 3 fall of odd-numbered years.

History 374. Foundations of Middle Eastern History. 3(1). 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. Emphasis on 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." Term paper and final exam. Prereq: History 101. Sem hrs: 3 fall.

History 375. Modern Middle Eastern History. 3(1). A survey of domestic and foreign affairs of the Middle East and North Africa from the rise of the Ottoman Empire to the present. Emphasis on the impact of imperialism, nationalism, constitutionalism, modernization, and reform. Analyzes independence movements of the twentieth century, the Arab-Israeli conflict, the Zionist and Islamic fundamentalist movements, the Gulf War, and other contemporary trends, problems, and challenges. Term paper and final exam. Prereq: History 101. Prior completion of History 374 is recommended but not required. Sem hrs: 3 spring.

History 376. A History of Space Power: Conquest of the New Frontier. 3(1). 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 between leadership, politics, society, technology, the USAF's ambivalent relationship with this new expression of military power, and the associated doctrinal challenges. Term paper and final exam. Prereq: History 202. Sem hrs: 3 spring of even-numbered years.

History 394. The American Way of War. 3(1). This course surveys the history of American warfare from the colonial period to the present. It focuses primarily on the nature of American

warfare, and addresses the question of whether there is a peculiar American way of war. The course deals with such issues as the American attitude toward war, civil-military relations, force structure, the role of professional leadership, and the impact of technology. Term paper and final exam. Prereq: History 202. Sem hrs: 3 spring of odd-numbered years.

History 457. History of Military Thought. 3(1). Historical investigation of the ideas of selected major military thinkers from the time of Machiavelli to the present. Emphasis is on those writers whose impact on evolving strategy and doctrine, whether on land, sea or in the air, has been most far-reaching. Term paper and final exam. Prereq: History 202 and C1C standing. Sem hrs: 3 fall.

History 480. Studies in American Civilization. 3(1). 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 will change each semester. Term paper and final exam. Prereq: History 351 or 352 or department permission. Sem hrs: 3 fall.

History 480. Studies in American Civilization. 3(1). 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 will change each semester. Final exam. Prereq: History 351 or 352 or department permission. Sem hrs: 3 fall.

History 482. History of Science and Technology. 3(1). Examines contemporary science in terms of its historical antecedents. Addresses science from the pre-Socratic Greeks to the present and traces the intellectual development of scientific revolutions in the 17th and 20th centuries. Interrelationship of physics, mathematics, and cosmology provides thematic continuity in addressing chemistry and the life sciences. The historical relationship between science and technology receives special treatment. Course is designed to suit engineering and science majors as well as those in the humanities. Research projects will be tailored to the disciplinary interests of students and the expertise of instructors. Term paper and final exam. Prereq: History 101. Sem hrs: 3 fall.

History 483. Great Americans. 3(1). Examines the role of the individual in American history. Through the illuminating prism of biography, the lives of selected prominent Americans will be studied in order 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. Political, military, business, labor, scientific, and literary figures will be featured. Term paper and final exam. Prereq: History 202. Sem hrs: 3 spring of even-numbered years.

History 495. Special Topics. 3(1). Selected topics in history. Term paper and final. Prereq: History 101. Sem hrs: 3 fall or spring.

History 498. Global Dimensions of History. 3(1). An examination of the dynamic forces influential in shaping global history. Explores time, space (geography), politics, economics and society in the context of universal and world history. Special attention is given to the impact of varying cultural perspectives upon individual historical understanding. The current process of

globalization and its many challenges are also explored. Term paper and final exam. Prereq: C1C standing. Sem hrs: 3 spring.

History 499. Independent Study. 3(0). Reading and research in any recognized area of historical study. Areas selected by instructor depend on student interest. Research paper or intensive reading program with written analysis of assigned works. Prereq: Department permission and 3.0 cum GPA. Sem hrs: 3 fall or spring.

HUMANITIES (Hum)

Offered by the Departments of the Humanities Division

Hum 200. Introduction to the Humanities. 3(1). Interdisciplinary course. A seminar-style introduction to the intellectual history of Western Civilization through literature, philosophy, the fine-arts, and the history of law and science. The course 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. Final exam. Prereq: Permission of the Division Chair. (Administered by the Humanities Division Chair). Sem hrs: 3 spring.

Hum 400. Humanities Seminar. 3(1). Interdisciplinary course. A seminar focused on the history of Western Civilization, through literature, the arts, and philosophy. Related topics include the history of law and history of 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. Final exam. Prereq: C1C or C2C standing, and permission of the Division Chair. (Administered by the Humanities Division Chair). Sem hrs: 3 fall.

Hum 430. The Holocaust. 3(1). 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 a pedagogical examination of critical lessons in the study of human history and behavior, as well as ethical issues. Through this investigation, cadets can also understand what it means to be a responsible citizen and soldier. Final exam. Prereq: History 101 or divisional permission. Sem hrs: 3 spring of even-numbered years.

Hum 461. Russian Literature. 3(1). A study of representative Russian authors (such as Pushkin, Chekhov, Dostoevsky, Tolstoy, Sholokhov, Pasternak, and Solzhenytsyn) in their historical and cultural setting and their impact on the shaping of the national character of the Russian people. Final exam. Sem hrs: 3 fall.

Hum 463. Far Eastern Literature. 3(1). An historical survey and analysis of major literary works of the Far East with emphasis on China and Japan. Final exam. Sem hrs: 3 fall or spring.

Hum 495. Special Topics. 1-3(1). Selected topics in humanities. Final exam or final report. Prereq: Department permission. Semester hours and offering time determined by department (not more than 3 sem hrs).

LAW

Offered by the Department of Law (DFL)

Law 220. Law for Air Force Officers. 3(1). A core course introducing cadets to the legal knowledge and skills they will need as Air Force officers and educated citizens. The course examines the nature of law and its role in American society and the military; provides an overview of the American 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. Final exam. Prereq: None. Sem hrs: 3 fall or spring.

Law 221. Legal Research, Writing, and Advocacy. 3(1). 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 will also practice advocacy skills. The course culminates with the students preparing a legal memorandum or equivalent legal document. Students will 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. Final project. Prereq/Coreq: Law 220. Sem hrs: 3 fall or spring.

Law 331. Crime and Criminal Justice. 3(1). An examination of crime and the criminal justice system. Special emphasis will be placed upon the definition of crime, the criminal justice system, and constitutional aspects of criminal law enforcement. Final exam or final report. Prereq: Law 220 or department permission. Sem hrs: 3 fall.

Law 340. Business Law. 3(1). An in depth study of law governing commerce and business organizations in the United States. Emphasis will be placed on contracts, formation of business organizations and laws which regulate the workplace environment. Final exam. Prereq: Law 220 or department permission. Sem hrs: 3 fall or spring.

Law 351. U.S. Constitutional Law. 3(1). In depth analysis of Supreme Court decisions having a fundamental impact on the American legal system, government, and citizens. Topics include the legal definition of war powers, and aspects of the Bill of Rights and the Fourteenth Amendment. Final exam or final report. Prereq: Law 220 and C1C or C2C standing. Sem hrs: 3 spring.

Law 360. Law and Literature. 3(1). In-depth study of selected literary works which deal with law as well as the literary qualities found in court opinions by noted jurists and in editorial journalism. Primary emphasis will be placed on developing persuasive writing skills, and secondary emphasis will be placed on oral analysis of subject texts. Final report. Prereq: English 211 and Law 220. Sem hrs: 3 fall.

Law 361. Modern Application of the Law of Armed Conflict (LOAC). 3(1). This course provides a detailed overview of the modern requirements and restrictions on military operations, with particular emphasis on combat operations between military forces. The legal framework that guides an officer at the strategic and operational level will be analyzed. Special focus on the

Geneva and Hague Conventions, along with more current agreements such as the Landmine treaty, and Rome/International Criminal Court treaty. Final exam or final paper. Prereq: Law 220 or Law 310. Sem hrs: 3 fall (beginning 2004).

Law 371. Environmental Law and Policy. 3(1). Comprehensive study of federal environmental law and current environmental issues emphasizing impacts on the Air Force mission. Areas covered include air and water pollution, solid and hazardous waste, NEPA, federal public lands, natural resources, and base closure. The course is designed to satisfy the needs and interests of cadets from all academic majors. Final exam or final report. Sem hrs: 3 spring.

Law 421. Law for Commanders. 3(1). This course is a continuation and expansion of Law 220, Law for Air Force Officers. Focus is on legal problems and issues of command and use of command tools. Examines command authority over military personnel, command authority over civilians living or working on base, military administrative law, and common legal concerns facing commanders and commanders' subordinates. Final exam. Prereq: Law 220. Sem hrs: 3 fall or spring (beginning fall 2003).

Law 456. National Security Law. 3(1). This course offers an examination of the domestic and international legal authority affecting US national security matters and the command and control of the key instruments of the national security, focusing on the US 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. Final exam or report. Prereq: Law 220 or Law 310 and C1C or C2C standing. Sem hrs: 3 fall.

Law 461. International Law. 3(1). A course studying the legal principles which govern relations among nations. Students will 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 law of the sea. Final exam or report. Prereq: Law 220 and C1C or C2C standing. Sem hrs: 3 spring.

Law 485. Contemporary Problems and the Law. 3(2). A seminar on the legal implications of contemporary social, economic, and political problems and the ability of the American legal system to solve those problems. This course affords the student the opportunity to integrate knowledge and expertise acquired in other law courses and further hone their analytical skills as they identify and seek to understand and resolve the complex legal issues they are likely to encounter following graduation. Final exam or final project. Prereq: Legal Studies major with C1C standing, or Department permission. Sem hrs: 3 spring.

Law 495. Special Topics. 3(1). Selected topics or topics in law. Final exam or final report. Prereq: Department permission. Sem hrs: 3 fall or spring.

Law 499. Independent Study. 3(0). 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. Final report or reports. Consideration for publication and staff position on department journal. Prereq: department permission. Sem hrs: 3 fall or spring.

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

Mgt 200. Introduction to Management. 2(1). This course focuses on how successful organizational leaders run their organizations using the management functions of planning, organizing, leading, and controlling. Through a survey of critical management topics, students learn to use these functions to analyze and improve their organizations and processes in increasingly complex, ambiguous, and dynamic environments. Mgt 200 helps students develop the adaptive capacity required to manage an organizations' resources—ideas, people, equipment, finances, and information. Other topics include decision-making, ethical and social responsibilities of organizations, information systems, and personal financial planning for Air Force officers. Final exam or final project. Coreq: Beh Sci 110. Sem hrs: 2 fall or spring.

Mgt 303. Management Perspectives. 3(2"). This course 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. Final exam or final project. Prereq: None. Sem hrs: 3 fall.

Mgt 341. Financial Accounting. 3(1). 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. Final exam or final project. Coreq: Concurrently enrolled in Mgt 303 or AIC approval. Sem hrs: 3 fall.

Mgt 342. Managerial Accounting. 3(1). 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, contribution margin analysis, measurement of cost of goods manufactured, capital budgeting, and management control systems. Final exam or final project. Prereq: Mgt 341 or AIC approval. Sem hrs: 3 spring.

Mgt 345. Human Managerial Systems I. 3(2). An 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 will apply to both the public and private sectors. Students learn through a variety of experiential exercises and case studies. Final

exam or final project. Coreq: Mgt 303 or AIC approval. Sem hrs: 3 fall.

Mgt 348. Power and Influence in Organizations. 3(1). Focus is on understanding how managers can effectively mobilize resources to be effective in their job. This course examines how power is acquired, retained, and used in organizations. In addition, it explores what effect power has on employees and the overall performance of the organization. Students learn through a variety of experiential exercises and case studies. Final exam or final project. Prereq: Mgt 200 and Econ 200. Sem hrs: 3 spring.

Mgt 361. Human Managerial Systems II. 3(2). This course is a continuation of Mgt 345 with greater depth and more emphasis on case studies and practical application of course concepts. Final exam or final project. Prereq: Mgt 303; Mgt 345 or AIC approval. Sem hrs: 3 spring.

Mgt 372. Introduction to Investing & Financial Responsibility. 3(1). This course provides an introduction to the personal financial planning process, budgeting, financial markets, investment vehicles (corporate stocks and bonds, mutual funds), and planning for retirement. Specific topics include budgeting, time value of money, risk and return, fundamental and technical analysis of stocks, bond valuations, and the basics of mutual funds. This course is introductory in nature and assumes no prior knowledge of accounting or financial markets. A term project provides experience in comprehensive financial planning—incorporating goals, budgeting, retirement planning, and investing. Final exam or final project. Prereq: Mgt 200 and Econ 200; designed for non-management majors. Sem hrs: 3 fall or spring.

Mgt 375. Marketing: 3(2). This course emphasizes how marketing concepts affect consumers, managers, and organizational strategic plans. This course includes the marketing concept, consumer and industrial markets, market research and segmentation, purchase behavior, product planning, channels of distribution, promotion, pricing, and international marketing. Application of contemporary theory to both critical issues in the private and public sectors is stressed through the use of seminars, case studies, field trips, and projects. Final exam or final project. Prereq: None. Sem hrs: 3 spring.

Mgt 382. Investing & Financial Responsibility. 3(1). This course provides an introduction to the personal financial planning process, budgeting, financial markets, investment vehicles (corporate stocks and bonds, mutual funds), analysis, and an introduction to estate planning. Topics include budgeting, time value of money, risk and return, fundamental and technical analysis of stocks, bond valuations, and the basics of mutual funds. This course assumes a prior knowledge of the principles developed in Financial Accounting. A term project provides experience in developing and analyzing investment opportunities. Final exam or final project. Prereq: Mgt 200 and Econ 200, or AIC approval. Coreq: Mgt 341. Sem hrs: 3 fall or spring.

Mgt 391. Management Information Systems. 3(1). A survey of current topics in management information systems. Topics covered include database management, telecommunications, and hardware trends. Students also 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 the use of seminars, case studies, field trips, and projects. Final exam or final project. Prereq: None. Sem hrs: 3 spring.

Mgt 392. Electronic Commerce. 3(1). The course focuses on the critical aspects of electronic commerce and provides complete coverage of this changing and challenging field. Case studies of commercial and government e-commerce will offer a real-world emphasis. Organizational strategies are analyzed, using examples of both successful and unsuccessful implementations. The main technologies used to implement online business activities will be explored. Students get hands-on web site development experience. Final exam and/or final project. Prereq: None. Sem hrs: 3 fall.

Mgt 405. Management Seminar. 0(1). A course for 1° Mgt majors that provides the opportunity for the presentation of cadet and faculty research, guest lectures, seminars on career and graduate school opportunities for Mgt majors in the Air Force, goal setting exercises, and applications of Mgt principles. Prereq: C1C Mgt major. Pass/Fail. Sem hrs: 0 spring.

Mgt 423. Managerial Economics. 3(1). 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 Geography.) Final exam or final project. Prereq: Econ 200 and Mgt 303 or AIC approval. Semester hrs: 3 fall or spring.

Mgt 437. Managerial Finance. 3(1). A study of financial decisions and their effects on the value of the firm. Emphasis is on 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. Final exam or final project. Prereq: Mgt 303 or AIC approval. Sem hrs: 3 fall.

Mgt 440. Management Lessons in Literature. 3(2). Through a collection of classic and contemporary stories, novels, and plays, this course provides a unique perspective of organizational life. The course 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. Final exam or term project. Prereq: Mgt 303 or AIC approval. Sem hrs: 3 fall or spring.

Mgt 446. Organizational Theory. 3(2). This 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 will study and apply a number of contemporary and practical theories for effectively diagnosing organizational situations and then designing activities that will create successful firms. Learning methods emphasize case studies, field trips, and analytical projects. Final exam or final project. Prereq: Mgt 303 or AIC approval. Sem hrs: 3 fall.

Mgt 472. Strategic Management. 3(2"). This course emphasizes strategy formulation and implementation to include such topics as the strategic management process, environmental forecasting and analysis, top-level decision-making, 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, and projects. Final exam or final project. Prereq: Mgt 303 or AIC approval. Meets for two hours every other lesson. Sem hrs: 3 spring.

Mgt 477. Production and Operations Management. 3(1). This course is an 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. We discuss qualitative and quantitative approaches for managing production, logistics, and service organizations to create higher quality and greater efficiency. Research project and field trip. Final exam or final project. Prereq: None. Sem hrs: 3 fall.

Mgt 485. Systems Acquisition Management. 3(1). Introduction to the acquisition process starting with development of a military requirement and continuing through the life cycle of a weapons system. The course examines the acquisition functions, including the roles of each of the functional areas which make up the government acquisition team such as contracting, program control, and engineering. The course uses current issues, problems and guest speakers to bring "real world" happenings into the course, so that students can see how the process works or fails to work. Final exam or final project. Prereq: None. Sem hrs: 3 spring semester of even-numbered years.

Mgt 495. Special Topics. 3(1 or 2). Selected topics in management. Final exam or final project. Prereq: department permission. Sem hrs and offering time determined by department (not more than 3 sem hrs).

Mgt 498. International Management. 3(2). 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. Final exam or final project. Prereq: Mgt 200. Sem hrs: 3 fall.

Mgt 499. Independent Study. 3(0). Tutorial investigation of a specific area of management. Final exam or final project. Prereq: Requires departmental approval of USAFA Form 0-498 prior to enrollment. Sem hrs: fall or spring.

- Mgt 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Mgt 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.
- Mgt 499C. Independent Study. 1(0). Sem hrs: 1 fall or spring.

MATHEMATICS (Math)

Offered by the Department of Mathematical Sciences (DFMS)

Math 104. Algebra/Trigonometry Skills Enhancement for Fourth Class Cadets. (2)1. Designed to help reinforce algebraic and trigonometric skills necessary for success in later courses. Basic

graphing, algebraic manipulation, and trigonometric calculations are covered in a self-paced online course until satisfactory competency is demonstrated. This course does not fill any graduation requirements and is only taken by cadets that score marginally on the USAFA algebra/trigonometry placement exam given shortly after arrival at USAFA. Final exam to demonstrate competency by the end of the semester. Prereq: None. Enrollment by recommendation of the Department of Mathematical Sciences. Pass/Fail. Sem hrs: 2 fall.

Math 130. Basic Math – Algebra and Trigonometry. 3(1). This course is designed to help reinforce algebraic and trigonometric skills necessary for success in the technical core. Basic graphing, algebraic manipulation, and trigonometric calculations are covered. This course may be used as an Academy option to fulfill graduation requirements. This course does not fulfill any major's requirements. Final Exam. Prereq: Can only be enrolled in the course by recommendation of the Department of Mathematical Sciences. Sem hrs: 3 fall.

Math 141. Calculus I. 3 (1). The study of differential calculus. Topics include functions and their applications to physical systems; limits and continuity; vectors and vector arithmetic; 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. Final exam. Sem hrs: 3 fall or spring.

Math 142. Calculus II. 3(1). A study of integral calculus with a focus on the Fundamental Theorems and their application. Topics include: estimating area under a curve, antiderivatives, numeric integration methods, antiderivative formulas for the elementary functions, integration by substitution, parts and tables, 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. Final exam. Prereq: Math 141. Sem hrs: 3 fall or spring.

Math 152. Advanced Placed Calculus II. 3(1). A more intense study of integral calculus for advanced-placed fourth-class cadets. Content is similar to Math 142, with the addition of an introduction to polar coordinates, vector arithmetic, and complex arithmetic. Additional emphasis is placed on the mathematical and physical applications in preparation for cadets interested in pursuing a technical major. Final exam. Prereq: C4C standing and qualifying performance on DFMS placement exam. Sem hrs: 3 fall.

Math 243. Calculus III. 3(1). Multivariate calculus, including vector functions, partial differentiation, directional derivatives, line integrals, and multiple integration. Maxima and minima in multiple dimensions and the method of Lagrange Multipliers. Solid analytical geometry to include lines, planes, and surfaces in 3-space. Designed for cadets who indicate an interest in a technical major. Cadets cannot take and receive credit for both Math 243 and Math 253. Final exam. Prereq: C or better in Math 142 or advanced-placement through DFMS exams. Waiver authority is Deputy Head for Academics. Sem hrs: 3 fall or spring.

Math 245. Differential Equations. 3(1). 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. Final exam. Prereq: Prior completion of Math 243 (or Math 253) is strongly recommended. Completion of Math 142 with a grade of C or better or advanced-placement through DFMS exams is required. Waiver authority is the DFMS Deputy Head for Academics. Sem hrs: 3 fall or spring.

Math 253. Advanced Placed Calculus III. 3(1). A more intense study of multivariate calculus for advanced-placed fourth-class cadets. Content is similar to Math 243. Additional emphasis is placed on mathematical and physical applications in preparation for cadets interested in pursuing a technical major. Final exam. Prereq: Advanced placement through DFMS exams. Sem hrs: 3 fall.

Math 300. Introduction to Statistics. 3(1). Descriptive statistics emphasizing graphical displays; designing experiments and studies; basic probability; normal and binomial distributions; sampling distribution of the mean; statistical inference including confidence intervals and hypothesis testing for population means, proportions, and differences in means; Analysis of Variance; correlation; and least squares regression. Math 300 is designed primarily for social science and humanity majors. It emphasizes the elements of statistical thinking, focuses on concepts, automates most computations, and has less mathematical rigor than Math 356. Final exam. Prereq: Math142/152 or department permission. Sem hrs: 3 fall or spring.

Math 310. Mathematical Modeling. 3(1). An 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. Math 310 is not appropriate for Math or OR majors. Final exam. Prereq: Completion of core math. Sem hrs: 3 spring.

Math 320. Foundations of Mathematics. 3(1). Course 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. A cadet cannot receive credit for both Math 320 and Math 340. Final exam. Prereq: Completed Math 142 or Math 152 with a 'C' or better. Waiver authority is the Deputy Head for Academics. Sem hrs: 3 fall or spring.

Math 340. Discrete Mathematics. 3(1). Useful for cadets 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. A cadet cannot receive credit for both Math 320 and Math 340. Final exam. Prereq: Comp Sci 110 and C3C standing or department permission. Sem hrs: 3 spring.

Math 342. Numerical Analysis with Differential Equations. 3(1). An introductory numerical analysis course with an emphasis on solving differential equations. Specific topics include finite precision arithmetic, root finding, fixed point iteration, interpolating polynomials, solving initial value problems via Runge-Kutta and multi-step methods including systems of equations, and solutions of linear systems of equations. The approach is a balance between the theoretical and applied perspectives with some computer programming required. Final exam. Prereq: Math 245 and Comp Sci 110. Sem hrs: 3 spring.

Math 344. Matrices and Differential Equations. 3(1). 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 economic growth. A cadet cannot receive credit for both Math 344 and Math 360. Final exam. Prereq: Math 142 or department permission. Sem hrs: 3 spring.

Math 346. Engineering Math. 3(1). Provides advanced mathematical concepts and skills necessary for technical disciplines. Topics include differential and integral vector calculus (divergence, directional derivative, gradient, curl, Divergence Theorem, Stokes' Theorem), analytical and numerical solutions to systems of linear ordinary differential equations (eigenvalues, eigenvectors, stability), and an introduction to partial differential equations (separation of variables, Fourier and Laplace transform methods). Final exam. Prereq: C or better in Math 243 (or Math 253) and Math 245. Waiver authority is the Deputy Head for Academics. Sem hrs: 3 fall or spring.

Math 356. Probability and Statistics for Engineers and Scientists. 3(1). 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, hypothesis testing, regression, and analysis of variance. This course is a core substitute for Math 300. Credit will not be given for both Math 300 and Math 356, nor for both Math 356 and Math 377. Designed for cadets in engineering, science, or other technical disciplines. Math majors and Operations Research majors should take the Math 377/378 sequence. Final exam. Prereq: Math 142/152. Sem hrs: 3 fall or spring.

Math 359. Design and Analysis of Experiments. 3(1). An introduction to the philosophy of experimentation and the study of statistical designs. The course requires a knowledge of statistics at the Math 300 level. Topics include analysis of variance for K treatments, various two- and three-level designs, interactions, unbalanced designs, and regression analysis. A valuable course for all science and engineering majors. Final project. Prereq: Math 300, Math 356, or Math 377. Sem hrs: 3 spring.

Math 360. Linear Algebra. 3(1). A first course in linear algebra. Vector spaces; linear transformations; systems of linear equations and matrices; eigenvalues and eigenvectors; inner product spaces; spectral theorem and quadratic forms; and the Jordan canonical form. Emphasizes theoretical foundation; computational aspects are covered in Math 344. A cadet can

not receive credit for both Math 344 and Math 360. Final exam. Prereq or coreq: Math 320 or department permission. Sem hrs: 3 fall.

Math 366. Real Analysis I. 3(1). A theoretical study of functions of one variable to include limits; continuity; differentiability; integrability; sequences and series; uniform convergence; Fourier series and convergence; fixed-point theorems and their applications. An essential prerequisite for graduate work in mathematical analysis, differential equations, optimization, and numerical analysis. Final exam. Prereq: Math 360 or department permission. Sem hrs: 3 spring.

Math 370. Introduction to Point-Set Topology. 3(1). 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. Final exam. Prereq: Math 320. Sem hrs: 3 fall of even-numbered years.

Math 372. Introduction to Number Theory. 3(1). 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. Final exam. Prereq: Math 320. Sem hrs: 3 spring of odd-numbered years.

Math 374. Combinatorics and Graph Theory. 3(1). 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. Final exam. Prereq: Math 340; Math 320 and Math 245 or Math 344 or Math 360 or department permission. Sem hrs: 3 spring of even-numbered years.

Math 377. Applied Probability and Statistics. 3(1). Descriptive statistics. Classical discrete and continuous random variables and probability distributions. Generalized univariate and bivariate distributions with associated conditional and marginal distributions. Central Limit Theorem. Single sample inferential statistics with applications using confidence intervals and hypothesis testing. Simple linear regression. This course is a core substitute for Math 300. Credit will not be given for both Math 300 and Math 377. This course is designed for Mathematical Sciences, Operations Research, and Economics majors. Final exam. Prereq: Math 243 (or Math 253). Sem hrs: 3 fall.

Math 378. Advanced Probability and Statistics 3(1). Advanced discrete and continuous random variables and probability distributions. Point estimation, joint, conditional, and marginal distributions. Functions of random variables and the Central Limit Theorem. Inferential statistics for categorical data and multiple samples including ANOVA. Nonparametric statistics. Design and analysis of experiments, including factorial, fractional, and response surface designs. Final exam. Prereq: Math 377 (or Math 356); Math 243 (or Math 253) highly recommended. Sem hrs: 3 spring.

Math 405. First-Class Seminar. 0(1). A problem solving course reviewing major areas and concepts of undergraduate mathematics. An assessment exam may be administered. Pass/Fail. Prereq: C1C standing in Mathematical Sciences major. Sem hrs: 0 fall.

Math 451. Complex Variables. 3(1). A valuable course for cadets 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. Final exam. Prereq: Math 346 or department permission. Sem hrs: 3 spring.

Math 465. Modern Algebra. 3(1). A valuable course for cadets 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. Final exam. Prereq: Math 320 or department permission. Sem hrs: 3 fall.

Math 467. Real Analysis II. 3(1). A theoretical study of functions of several variables to include topology of cartesian spaces, compact and connected sets, convergence of sequences and functions, continous functions, fixed point theorems, contractions, Stone-Weierstrass approximation theorems, differentiation, partial differentiation, mapping theorems, and Implicit Function Theorem. Final exam. Prereq: Math 366 or department permission. Sem hrs: 3 fall of odd-numbered years.

Math 468. Dynamical Systems. 3(1). The study and application of linear and nonlinear differential equations to physical systems from both computational and analytical points of view. Topics vary. Typical choices include systems of differential equations, stability analysis, bifurcations, maps, and chaos. Final exam. Prereq: Math 346 or department permission. Sem hrs: 3 fall.

Math 469. Partial Differential Equations. 3(1). Partial differential equations with applications to heat flow and wave motion. Solutions of boundary value problems. Introduction to Fourier series. Methods of solution include separation of variables and eigenfunction expansion. Final exam. Prereq: C or better in Math 346. Sem hrs: 3 fall.

Math 470. Mathematical Physics. 3(1). An introduction to various mathematical topics needed in graduate-level physics and applied mathematics courses. Topics vary; typical choices include special functions (Legendre polynomials, Bessel functions, etc.), calculus of variations, complex functions (Laurent series, contour integration, and the Residue Theorem), Fourier series and their convergence properties, integral transform concepts (Fourier and Laplace transforms, Green's functions), dynamical systems. Final exam. Prereq: Math 346. Sem hrs: 3 spring.

Math 495. Special Topics. 3(1). Selected advanced topics in mathematics. Final exam or final report. Prereq: Department permission. Sem hrs: 3 fall or spring.

Math 499. Independent Study and Research. 3(0). Individual study and/or research under the direction of a faculty member. Oral midterm and final; final paper. Prereq: Department permission. Sem hrs: 3 fall or spring.

- Math 499A. Independent Study and Research. 2(0). Sem hrs: 2 fall or spring.
- Math 499B. Independent Study and Research. 1.5(0). Sem hrs: 1.5 fall or spring.

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

Mech Engr 312. Thermal Fluids Systems Engineering I. 3(1). 1st and 2nd Laws of Thermodynamics applied to open and closed systems; basic modes of heat and work processes, with a concentration on conduction. Mass and momentum conservation, entropy balance. Cycle concepts as applied to Carnot cycle. Properties of thermodynamic substances, to include phase diagrams, ideal gases, and pure substances. Fundamental aspects of fluid statics. Basic engineering plant component analysis. Laboratory methods and applications. Emphasis on developing problem solving methods applied to thermal-fluids systems, and on communication skills. Final exam. Prereq: Engr Mech 120, Math 142. Coreq: Math 243 (or Math 253). Sem hrs: 3 fall.

Mech Engr 325. Engineering System Dynamics. 3(1). 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. Final exam or project. Prereq: Engr Mech 320, El Engr 231. Coreq: Math 346. Sem hrs: 3 fall.

Mech Engr 341. Thermal Fluids Systems Engineering II. 3(1). Continuation of Mech Engr 312. Navier-Stokes equations and applications. Fluid flow and heat transfer boundary layer applications. Bernoulli and mechanical energy equations. Convection heat transfer, with a concentration on heat exchangers. Dimensional analysis, modeling, and similitude. Isentropic efficiencies of plant components. Laboratory methods and applications. Emphasis on developing problem solving methods applied to thermal-fluids systems, and on communications skills. Laboratory methods and applications. Final exam. Prereq: Mech Engr 312. Coreq: Math 346. Sem hrs: 3 spring.

Mech Engr 370. Introduction to Machine Design. 3(1). 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. Emphasis on stress analysis and design trade-offs. Final exam or final project. Prereq: Engr Mech 330, Engr Mech 320, Engr Mech 350 (recommended). Administered by the Department of Engineering Mechanics. Formerly Mech Engr 470. Sem hrs: 3 spring.

Mech Engr 396. Mechatronics. 3(1). Cadets will learn the 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. Open only to Engineering majors with Department of Engineering Mechanics permission. Final exam or final project. Prereq: Engr Mech 330, 'B-' grade or higher in El Engr 231. Sem hrs: 3 fall.

Mech Engr 441. Thermal Fluids Systems Engineering III. 3(1). 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.). Psychrometric processes. 1-D compressible flow with application to turbomachinery and varying area channels, to include normal shocks. Analysis of turbomachinery. Laboratory methods and applications. Emphasis on developing problem solving methods applied to thermal fluids systems, and on communications skills. Final exam. Prereq: Math 346 and Mech Engr 341. Sem hrs: 3 fall.

Mech Engr 467. Energy Conversion. 3(1). 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. Design project. Final exam or final project. Prereq: Mech Engr 441. Sem hrs: 3 spring.

Mech Engr 490. Automotive Systems Analysis for the Engineer. 3(1). An 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, overall vehicle performance including economy. Final report or final exam. Field trip. Prereq: Engr Mech 320 or department permission. Sem hrs: 3 fall.

Mech Engr 491. First-Class Capstone Design Project I. 3(2). Capstone engineering design experience for the Engineering Mechanics and Mechanical Engineering majors. Emphasis placed on 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. Final report. Prereq: Engr Mech 320, Engr Mech 330, Engr Mech 350, C1C Standing, and team advisor approval. Coreq: Engr Mech 460 or Aero Engr 471. Sem hrs: 3 fall.

Mech Engr 492. First-Class Capstone Design Project II. 3(2). Capstone engineering design experience for the Engineering Mechanics and Mechanical Engineering majors. Emphasis placed on 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. Final report. Prereq: C1C standing, Mech Engr 312, Mech Engr 341, Engr Mech 320, Engr Mech 330, Engr Mech 350, Engr Mech 460 or Aero Engr 471. Sem hrs: 3 spring.

Mech Engr 499. Independent Study. 3(0). Individual study, research, or design on a topic

established with the permission of the Department Head. Prereq: Departmental approval of USAFA Form 0-498 prior to enrollment. Final report. Sem hrs: 3 fall or spring.

- Mech Engr 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Mech Engr 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.
- Mech Engr 499C. Independent Study. 1(0). Sem hrs: 1 fall or spring.

METEOROLOGY (Meteor)

Offered by the Department of Economics and Geography (DFEG) and the Department of Physics (DFP)

Meteor 300. Aviation Meteorology. 3(1). A survey course in aviation weather. Integrates fundamental meteorological principles with application to aviation. Topics include atmospheric composition, properties and structure, basic radiative transfer, fundamental atmospheric forces, vertical motion and stability, atmospheric circulation systems, aviation weather hazards, and aviation weather resources. Not open to Meteorology majors. Administered jointly by the Department of Physics and the Department of Economics and Geography.. Final exam. Prereq: Physics 215. Sem hrs: 3 fall.

Meteor 320. Introduction to Atmospheric Science. 3(1). A survey course in the fundamentals of meteorology. Emphasis will be placed on 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. Administered by the Department of Physics. Final exam. Prereq: Physics 215. Sem hrs: 3 spring.

Meteor 325. Weather Data, Analysis and Quantitative Methods. 3(1). An 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. Practical application of the above quantitative techniques to weather charts and vertical atmospheric soundings are emphasized. Administered by the Department of Economics and Geography. Final exam. Prereq: Math 243 (or Math 253). Coreq: Meteor 320. Sem hrs: 3 fall.

Meteor 330. Atmospheric Physics. 3(1). 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. Administered by the Department of Physics. Final exam. Prereq: Math 243 (or Math 253) and Meteor 320. Sem hrs: 3 fall.

Meteor 352. Climatology. 3(1). An 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. Administered by the Department of Economics and Geography. Final exam. Prereq or Coreq: Soc Sci 112. Sem hrs: 3 spring.

Meteor 405. First-Class Seminar. 0(1). An applications-based course providing cadets with an operational overview of the weather AFSC, and its support of Air Force and Army operations worldwide. Topics include the history of AF weather, the development of weather effects matrices, and operational weather support to AF, Army and space operations, including a mock overseas deployment of an operational aviation squadron. Open only to Meteorology majors. Administered jointly by the Department of Physics and the Department of Economics and Geography. Pass/Fail. Prereq: C1C Standing. Sem hrs: 0 spring.

Meteor 430. Atmospheric Dynamics I. 3(1). An 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. Administered by the Department of Physics. Final exam. Prereq: Meteor 325 and Meteor 330. Sem hrs: 3 spring.

Meteor 431. Atmospheric Dynamics II. 3(1). 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. Administered by the Department of Physics. Final exam. Prereq: Meteor 430. Sem hrs: 3 fall.

Meteor 440. Synoptic-Dynamic Meteorology Laboratory. 3(1). A 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. Administered jointly by the Department of Economics and Geography and the Department of Physics. Final exam. Prereq: Meteor 325 and Meteor 330. Coreq: Meteor 430 and Meteor 451. Sem hrs: 3 fall.

Meteor 451. Synoptic Meteorology. 3(1). 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. Administered by the Department of Economics and Geography. Final exam. Prereq: Meteor 325 and Meteor 330. Coreq: Meteor 430 and Meteor 440. Sem hrs: 3 fall.

Meteor 452. Mesoscale Meteorology. 4(2). Study of the structure, development and evolution of mesoscale weather systems. Topics include fronts and jet streaks, instabilities, gravity waves, convective storms, squall lines, tornadoes, and mesoscale convective complexes. Introduction to analysis techniques and nowcasting. Extensive use of real-time satellite and Doppler radar data and numerical forecast products in meteorological laboratory. Administered by the Department of Economics and Geography. Final exam. Prereq: Meteor 440 and Meteor 451. Sem hrs: 4 spring.

Meteor 465. Marine and Tropical Meteorology. 3(1). 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. Particular emphasis will be placed on how these environments affect joint Naval and Air Force operations. Administered by the Department of Economics and Geography. Final exam or final project. Prereq: Meteor 451. Coreq: Meteor 452. Sem hrs: 3 spring.

Meteor 499. Independent Study. 3(0). Individual research under the direction of a faculty member. Research paper or final project. Prereq: Department permission. Sem hrs: 3 fall or spring.

- Meteor 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.

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

MSS 100: Military Theory, Strategy, and Officership. 3(1). Provide the professional cornerstone of the Academy core foundation for future officer development through the exploration of military theories and concepts used to develop military strategy. Differentiate and explain the principles of war and the functions of air, space, and information power. Analyze various approaches to military strategy. Appreciate roles and responsibilities of officership by examining the military as a profession, personal accountability, and team building in military organizations. Final paper. Prerequisite: None. Sem hrs: 3 fall or spring.

MSS 365. Developing the Military Strategist. 3(1). Examine how military strategists shape the international environment, prepare for the future, recognize threats to national security, and develop military responses. Explore military theories of air, sea, space, information, and land warfare, and the context in which these ideas develop. Analyze case studies to identify elements that lead to success or failure. Investigate future national security challenges, and using strategy formulation tools, develop and practice the skills necessary to methodically and aggressively dominate the battlespace by coercing, punishing, disabling, delaying, containing, decapitating, denying, or destroying an adversary. Prereq: None. Sem hrs: 3 spring.

MSS 379. Research Methods in Military Strategic Studies. 3(1). Introduce and explain research methods and their application to Military Strategic Studies. Provide 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. The seminar director will assign each cadet a faculty thesis advisor to provide additional research mentorship. This course will conclude with a final paper that will be developed into a thesis in the MSS 498 Capstone Thesis in Military Strategic Studies course. Prereq: None. Sem hrs: 3 fall.

MSS 381. Principles and Practice in Air and Space Warfare. 3(2). This course examines relationships among progressive technology associated with modern air and space platforms, human procedural accommodations, and benefits and challenges to operational and strategic objectives. Air and space technology such as modern instrumentation, power plants, satellite and land-based navigation and positioning receivers, aerodynamic lifting and drag surfaces, and night optical devices are matched with human cognition and ergonomic capabilities and limitations.

These dynamics are explored and experienced in available aircraft, computer based aviation flight training devices, visual flight simulators, and space education lab. Actual case studies are examined in light of operational and strategic successes and failures. Final project. Prereq: None. Sem hrs: 3 fall or spring.

MSS 382. Air and Space Power Theory. 3(1). Provide a foundation for military officers to innovate beyond current doctrinal boundaries through critical analysis of air and space power theories. Identify, explain, and examine existing propositions, frameworks, and assumptions of air and space power doctrine and theory. Through case studies and seminar discussion, analyze alternatives to current approaches of air and space power employment and their relationship to information power. Examine current and notional characteristics of air and space platforms and investigates future requirements of air and space platforms. Evaluate air and space issues such as the integration and/or separation of air and space power. Final exam. Prereq: None. Sem hrs: 3 fall.

MSS 383. Air and Space Strategy and Instructor Qualification 3(2). This course explores doctrinally relevant case studies that have significant operational and strategic ramifications. Cadets learn concepts and how to instill in others air and space concepts using a T-41 Airborne Conceptual Application and Validation (TACAV) laboratory, visual flight simulators, aviation flight training devices, and the space education laboratory. MSS 383 cadets are mentored by Cadet Air and Space Instructors simultaneously enrolled in MSS 483. Periodic combined seminars led by MSS 483 students generate debate and analysis of complex scenarios. Upon the successful completion of this course, cadets are designated Cadet Air and Space Instructors. Final project. Prereq: Department approval. Sem hrs: 3 fall and spring.

MSS 385. Information Operations Doctrine and Strategy. 3(1). Seminar participants will discuss gaining 'information dominance' over an adversary. It examines the "other half" of controlling and exploiting air and space by exploring the military applications of command, control, communications, computers, intelligence systems, electronic warfare, and space operations. Cadets analyze the potential of these systems to enhance our capacity to wage war and employ innovative means to defeat an adversary. Ultimately, they look at the potential influence of these systems on force structure, strategy and doctrine. Final exam or final project. Prereq: MSS major or departmental approval. Sem hrs: 3 spring.

MSS 395. Air Combat Operations. 3(1). This course examines the employment of air strategy, doctrine, and tactics in combat operations supporting US national defense objectives. Studies include a comparison of roles, missions and operational capabilities in a variety of aerial platforms, battle management and aircrew duties, combat support assets, and planning skills required for planning global attack operations. Cadets develop, plan, and brief a combat mission scenario and experience its conceptual execution in a variety of simulations. Final briefing. Sem hrs: 3 fall or spring.

MSS 400. Joint and Coalition Warfare. 3(1). This 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. Emphasis is

placed on teamwork. Through the use of wargaming scenarios and teaching cases, cadets use, reinforce, and validate concepts taught in the classroom. Final exam or final paper. Prereq: MSS 100. Sem hrs: 3 fall or spring.

MSS 463. Military Innovation and Officership. 3(1) This course seeks to provide insight into the nature of military innovation in peace and war. More specifically, the course will focus on officership and its relationship to the various factors that promote-or inhibit-significant changes in military technology, doctrine, and organization. By examining cases of successful and unsuccessful peacetime and wartime innovation across the various mediums of warfare, cadets consider applications and implications of officership in a variety of operational settings. The overriding objective is to identify the forces that carry innovation forward with special emphasis on the professional qualities required of officers who seek to lead significant changes to established operational practices. Course paper. Prereq: Beh Sci 310. Sem hrs: 3 spring.

MSS 466. American Civil-Military Relations. 3(1). This course addresses some of the major issues confronting the American military at the beginning of the new century. It will begin with the theories of Samuel Huntington and Morris Janowitz that have provided much of the foundation for the study of civil-military relations in the United States. Contemporary issues will include the possible mismatches between available resources and assigned missions; the likelihood of an increasing gap between political and military cultures; racial, gender, and sexual orientation issues; and the effects of the external environment and threat perceptions on civil-military relations. Final paper or final exam. Prereq: None. Sem hrs: 3 fall.

MSS 468. Weapons Technology, Strategy, and Employment. 3(1). This course examines relationships between weapons technology and strategies for support of joint/combined force air component commanders. Studies include capabilities of combat and combat support assets, weapons of mass destruction, planning skills required to build strike packages, and strategies/approaches to the application of air and space power. In the final project, cadet teams forecast a weapons technology or capability and evaluate implications for employment. Prereq: MSS 395. Sem hrs: 3 spring.

MSS 483. Specialized Applications and Air and Space Strategy. 3(2). Cadets serve as air and space instructors, applying and validating intellectual concepts associated with the exploitation of the future battlespace. Cadets become deeply immersed in air and space theory and doctrine while serving as instructors in educational laboratories such as a T-41 Airborne Conceptual Application and Validation (TACAV) laboratory, visual flight simulators, aviation flight training devices, and the space education laboratory. Cadets periodically lead combined seminars to generate debate and analysis of complex scenarios and interact with visiting dignitaries. Prereq: MSS 383. Sem hrs: 3 fall or spring.

MSS 485. Space Operations and the Warfighter. 3(1). This course examines the employment of space power strategy, doctrine, and tactics supporting U.S. national defense objectives. Studies include the evolution of military space missions, current space force structure, introductions to space law and orbital mechanics, military space doctrine, and an emphasis on the application of space power roles. Experience the capabilities of space assets first-hand. Cadets research and brief an emerging space issue. Final paper. Prereq: C1C, C2C, or C3C standing. Sem hrs: 3

fall.

MSS 495. Special Topics. 1-3(1). Selected topics related to military doctrine, operations and strategy. Prereq: department permission. Sem hrs: 1-3 fall or spring

MSS 498. Capstone Thesis in Military Strategic Studies. 3(1). This 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. Final Paper. Prereq: MSS 379. Sem hrs: 3 spring.

MSS 499. Independent Study. 3(0). Individual study and/or research under the direction of a DFMI instructor. No final. Prereq: Department permission. Sem hrs: 3 fall or spring.

MILITARY TRAINING (MilTng)
Offered by the 34th Training Squadron (34 TRS)

Mil Tng 100. Basic Cadet Training (BCT). 0(0). Student Course. BCT is a 5 1/2-week transition period from civilian to military life. Indoctrination of the overall Academy program: cadet regulations, the Honor Code, manual of arms, drill, customs and courtesies, introduction to basic Air Force weapons, a field encampment, and other general military subjects. This course is a graduation requirement. Pass/Fail. No final. Coreq: Phy Ed 100. Sem hrs: 0 summer.

Mil Tng 101. Operation Air Force Program (OpsAF Non-Comm). 0(0). Student Course. This three week program is conducted at Air Force installations worldwide. Cadets will learn the roles, responsibilities, and expectations of enlisted personnel. Each cadet will gain an enlisted perspective. Pass/Fail. Debrief/critique serves as final. Sem hrs: 0 summer.

Mil Tng 201. Operation Air Force Program (OpsAF-3Lt). 0(0). Student Course. This three week program is conducted at Air Force installations worldwide. Cadets will learn the roles, responsibilities, and expectations of second lieutenants. Each cadet will understand the Air Force organization and gain a broad officer perspective in both support and operational squadrons. This course is a graduation requirement. AETC leadership and Civil Engineering—Field Engineering Research Lab (CE-FERL) are substitute courses that fulfill the graduation requirement. Pass/Fail. Debrief/critique serves as final. Sem hrs: 0 summer.

Mil Tng 202. Operation Air Force Staff. 0(0). Selected cadets will assist the Operation Air Force CICs with managing all aspects of the Operation Air Force program to include: administrative support, transportation arrangements, dormitory management, cadet accountability, and base program manager coordination. This course is only offered to prior enlisted cadets that do not require, or will not benefit from, Mil Tng 101. Pass/fail. Sem hrs: 0 summer.

Mil Tng 210. Space Orientation. 0(0). Student Course. This 10-day program is conducted at Air Force installations and serves as indoctrination to space operations. The program consists

mostly of tours but does offer limited hands-on participation in space operations. Course provides an overview of how space contributes to air and space domanance. Pass/fail. Debrief/critique serves as final. Sem hrs: 0 summer.

Mil Tng 260. Global Engagement (GE). 0(0). Student Course. Third-class cadets deploy into a pre-existing, bare-base location and are exposed to the challenges they will face as they join the Expeditionary Aerospace Forces (EAF) of the 21st century. The 10-day program includes EAF academics; 5 days of pre-deployment training - to include DoD certified training that can be transferred to the first active duty assignment (Chemical Warfare Training, and Terrorism/Anti-Terrorism); 5 days deployment to Jack's Valley Bare-Base location; and reconstitution. This course is a graduation requirement. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 301. Operation Air Force Program (OpsAF-Brevet Lt). 0(0). Student Course. This three week program is conducted at Air Force installations worldwide. Cadets will learn the roles, responsibilities, and expectations of company grade officers in an AFSC focused program. Each cadet will understand the Air Force organization and have an effort focused on learning what a specific AFSC duty entails. OpsAF-Brevet Lt Deployed exposes selected cadets to AEF concepts through deployment to a Combatant Command's AOR. This exposure is anywhere from three to six weeks in duration. Each cadet will understand the Expeditionary Wing contribution to the Combatant Commander's mission and will be indoctrinated into the mobility readiness and deployment line process. Select CSRP activities are substitute courses that fulfill the Mil Tng 301 OpsAF requirement. Pass/Fail. Debrief/critique serves as final. Sem hrs: 0 summer.

Mil Tng 302. Navy Programs. 0(0) Student Course. First- and second-class cadets volunteer for various Navy training courses. Specific courses will vary from summer to summer. Programs are two to three weeks in length. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 303. Army Airborne. 0(0). Student Course. First- and second-class cadets volunteer for Army Airborne training courses. Training is conducted at an army location by U.S. Army personnel. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 304. Army Air Assault. 0(0). Student Course. First- and second-class cadets volunteer for Army (Air Assault) training courses. Training is conducted at an army location. Program is two weeks in length. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 305. Marine Bulldog. 0(0). Student Course. First- and second-class cadets volunteer for Marine training. The program is two to three weeks in length. This program is a prerequisite to cross commissioning to the Marine Corps Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 307. BSA Philmont Ranger. 0(0). Career Broadening. Positions at Philmont Scout Ranch in Cimarron, New Mexico, as rangers or instructors in the staff camp areas. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 315. Operations Center. 0(0). Military Leadership. Staff is responsible for manning the center 24 hours a day. Duties include maintaining wing locator information, emergency

procedures notification, and information dissemination. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 332. Summer Seminar. 0(0). Career Broadening. Cadets will serve as counselors and escorts for approximately 600 high school students from all 50 states. During the two 1-week sessions, the high school students are housed in Vandenberg Hall, attend scientific workshops, tour the Academy and surrounding areas, participate in recreational sports and attend various evening programs. This program is first period only. Qualified cadets will help with some of the workshops. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 351. Civil Engineering Field Engineering and Readiness Lab (FERL) Leadership. 0(0). Military Leadership. First-class Civ Engr or Env Engr cadets selected by the Department of Civil and Environmental Engineering serve as Squadron Commander, Chief of Operations, Flight Commanders, and Logistics Officers for Civ Engr 351. Cadets lead second-class students through hands-on engineering/construction activities, a variety of team building activities, and field trips. Flight Commanders deploy with students to active duty AF installations on Operation Civil Engineering Air Force (OpsCEAF). Logistics Officers and leadership cadre prepare site and activities at the Field Engineering and Readiness Laboratory (FERL) for Civ Engr 351. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 352. SAME/USAFA Engineering and Construction Camp Cadre (CE-SAME). 0(0). Career Broadening. First-class Civ Engr or Env Engr cadets selected by the Department of Civil and Environmental Engineering serve as Flight Commanders for high school students during the second summer period at the Field Engineering and Readiness Laboratory (FERL) complex in Jack's Valley. Cadets lead the students through a variety of team building activities/competitions, hands-on engineering/construction activities, and field trips. Cadets prepare site and activities prior to camp while leading and mentoring their students during the camp. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 360. Global Engagement Cadre. 0(0). Military Leadership. Selected cadets will serve as the leadership for the students enrolled in GE, managing all aspects of the GE program to include: Security Forces, Services, Civil Engineering, administrative support, transportation arrangements, dormitory management, cadet accountability, and base program manager coordination. Pass/Fail. Sem hrs: 0 summer.

Mil Tng 400/402. Basic Cadet Training Cadre. 0(0). Military Leadership. Leadership positions as instructors, officers or NCOs in the cadet chain of command during Basic Cadet Training. Some areas include: Combat Arms Training, Obstacle Course, Assault Course, Confidence Course, Self-Aid/Buddy Care, Leadership Reaction Course, and Ground Combat Familiarization course. Pass/Fail. No final. Administered by the 34 TRG/CC and 34 TRS/OPS. Sem hrs: 0 summer.

Mil Tng 401. Operation Air Force Cadet-in-Charge. 0(0). Military Leadership. Selected cadets will assist the Operation Air Force Program Manager with managing all aspects of the Operations Air Force program to include: administrative support, transportation arrangements, dormitory management, cadet accountability, and base program manager coordination.

Pass/Fail. Sem hrs: 0 summer.

Mil Tng 404. Aviation Group. 0(0). Career Broadening. Cadet officer and NCO leadership positions maintaining command, control, accountability, and providing billeting for all cadets involved in summer Aviation courses. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 407. Mission Support Group. 0(0). Career Broadening. Cadet Officer and NCO leadership positions maintaining command, control, and accountability. Provide billeting for all cadets taking summer academic courses, Summer Seminar, Sports Camp, and transient cadets using cadet area facilities. Pass/Fail. No final. Administered by the 34 TRG/CC. Pass/Fail. Sem hrs: 0 summer.

Mil Tng 408. Sports Camp. 0(0). Career Broadening. First-class cadets accepted by the Athletic Department program manager to work sports camps during the first summer period. Pass/fail. No final. Sem hrs: 0 summer.

Mil Tng 411. AETC Leadership. 0(0). Military Leadership. Leadership positions with a Basic Military Training Squadron at Lackland AFB, TX, as assistants to Military Training Instructors and as basic airmen training instructors and counselors. AETC Leadership meets the requirements for a military training leadership program and for Operation Air Force. Cadets cannot be scheduled for Operation Air Force after completing AETC Leadership. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 412. Falconry. 0(0). Career Broadening. Train recently hatched falcons for upcoming football season performances, train falcons on hand, public relations work, and assist in renovations/repairs of mews and equipment. Only cadet falconers are eligible. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 435. Cadet Wing Leadership. 0(0). Military Leadership. Selected cadets will perform in Cadet Wing Command functions managing all aspects of the Cadet Wing to include: Wing Commander, Deputy Commander, Superintendent, Director of Operations, and Leadership Staff. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 439. Summer Research. 0(0). DF Coordinated Program. Summer Research is for first-class cadets. They spend 38 days at a government research facility working on a project, usually in their major's area. Summer Research participants will be scheduled for a third period leadership program. Cadets cannot take Operation Air Force (or other TDY programs) in conjunction with Summer Research. Cadets must be selected by their major's department for this program. Pass/fail. No final. Sem hrs: 0 summer.

Mil Tng 441. Cadet Summer Language Immersion Program (CSLIP). 0(0). DF Coordinated Program. This is an intensive foreign language and cultural study program at an accredited foreign university or language institute. USAFA currently sends eligible cadets to immersion programs in the Middle East, China, Russia, Japan, France, Germany, Spain, and Latin America. All third-class or second-class foreign language students are eligible to apply for the program, but preference is given to Arabic, Chinese, and Russian students. The program runs for four weeks, from Graduation Week through the end of the first summer period; participation is in lieu

of leave. Participation in CSLIP provides cadets with across-the-board significant improvement in language skills and cultural understanding, as well as the ability to function with confidence in international/foreign environments. Pass/fail. No final. Sem hrs: 0 summer.

Mil Tng 442. Olmsted Foundation Language and Cultural Immersion Program. 0(0). Provides unique cultural and language learning opportunities for USAFA faculty, staff, and cadets to develop and submit their own proposals to study specific international issues, cultures, histories, and languages in a variety of foreign countries around the world. Like CSLIP, preference is given to proposals to travel to the Middle East/Africa, China, and Russia; each proposal must have a strong foreign culture and foreign language component as its primary focus. Approximately 7 to 10 proposals (30 to 40 cadets) are approved from over 25 submitted each year; most travel takes place during Graduation Week through the end of the first summer period. This program is in lieu of leave. Pass/fail. No final. Sem hrs: 0 summer.

Mil Tng 444. Summer Leave. 0(0). Summer leave. No Military Training credit. Sem hrs: 0 summer.

Mil Tng 446. Special Leave. 0(0). First-, second-, and third-class cadets requiring leave at a certain time during the summer. Examples include: third-class football players and cadets requiring leave for weddings or other special occasions. All requests for special leave will be submitted to 34 TRS/DOS by 15 January for consideration. No Military Training credit. Sem hrs: 0 summer.

Mil Tng 447. Medical Leave. 0(0). First-, second-, and third-class cadets requiring leave at a certain time for scheduled medical operations or when sent home on recuperative leave. No Military Training credit. Sem hrs: 0 summer.

Mil Tng 451. Honor Staff. 0(0). Career Broadening. First- and second-class cadets who teach honor lessons to basic cadets and process honor cases during the summer. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 452. Media Staff. 0(0). Career Broadening. First- and second-class cadets selected for cadet-in-charge (CIC) duty for media. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 492. Military Strategic Studies Application Laboratories. 0(0). DF Coordinated Program. Cadet Air and Space Instructors use a number of educational laboratories such as available aircraft, Air Warfare Laboratory simulators, aviation flight training devices, and the Space Education Laboratory. Cadets interact with visiting dignitaries such as congressional delegations, high school and university counselors, and General Officers. In addition, cadets host the air and space application portions of Summer Seminar, conduct integrated field studies, teen aviation camp, space camp, and ROTC summer visitations. Prerequisite: MSS 383 – Air and Space Strategy and Instructor Qualification. Pass/Fail. No final. Sem hrs: 0 summer.

Mil Tng 499. Internship. 0(0). DF Coordinated Program. First-class cadets work special research/internships at various TDY locations or on the Academy. These are individual programs structured for each cadet enrolled. The program may be scheduled for any one of the

three summer periods. Internships may be longer than three weeks. Examples of such programs are the Georgetown and Washington Internship programs. Pass/fail. No final. Sem hrs: 0 summer.

<u>OPERATIONS RESEARCH</u> (Ops Rsch)

Offered by the Department of Computer Science (DFCS), Department of Economics and Geography (DFEG), Department of Management (DFM), and Department of Mathematical Sciences (DFMS)

Ops Rsch 310. Systems Analysis. 3(1). This course provides an introduction to rigorous quantitative modeling methods that have broad application. The course focuses on the mathematics of the models, the computer implementation of the models, and the 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 USAFA. The course consists of six distinct blocks: decision analysis and utility theory, linear and nonlinear optimization, project management, queuing theory, simulation, and the systems approach to engineering and decision-making. Administered by the Department of Management. Instruction provided by inter-departmental Operations Research faculty. Final exam. Prereq: Comp Sci 110, Math 142. Sem hrs: 3 fall or spring.

Ops Rsch 321. Probabilistic Models. 3(1). Selected probabilistic models (such as random walks, Markov Chains, queues, and reliability models) are analyzed as stochastic processes. Administered by the Department of Mathematical Sciences. Final exam. Prereq: Math 356, Math 377, or department permission. Sem hrs: 3 spring.

Ops Rsch 405. First-Class Seminar. 0(1). A course for First-Class Operations Research majors that provides for presentation of cadet 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 Operations Research. The class meets once each week. Open only to First-Class Operations Research majors. Pass/Fail. Prereq: C1C standing. Sem hrs: 0 fall.

Ops Rsch 411. Topics in Mathematical Programming. 3(1). Topics include linear programming (with sensitivity analysis and applications) and non-linear programming. Both the theory and the computer implementation of these techniques are addressed. Administered by the Department of Mathematical Sciences. Final exam. Prereq: Math 344 or Math 360; and either Ops Rsch 310 or department permission. Sem hrs: 3 fall.

Ops Rsch 419. Capstone in Operations Research: Case Studies. 3(2). The study of methodologies associated with business and operations management. A case-based course intended to provide the proper foundation neeeded to conduct effective analyses supporting a variety of scenarios. Students will evaluate various cases, develop plans for and conduct analyses, and create effective written and oral presentations. Develop capstone project proposal for Ops Rsch 420. Administered by the Department of Management. Final project. Prereq: Ops Rsch 310; C1C standing in the Ops Rsch or Sys Eng Mgt majors or course director approval. Sem hrs: 3 fall.

Ops Rsch 420. Capstone in Operations Research. 3(2). Project development and implementation for real-world clients using advanced operations research techniques with emphasis on problem recognition, model formulation, and Air Force applications. Administered by the Department of Management. Final project. Prereq: Ops Rsch 419, C1C standing in the Ops Rsch or Sys Eng Mgt majors, or course director approval. Sem hrs: 3 spring.

Ops Rsch 495. Special Topics. 1-3(1). Selected advanced topics in Operations Research. Final exam or final report. Offered by DFCS, DFEG, DFM or DFMS. Prereq: department permission. Sem hrs and offering time determined by department.

Ops Rsch 499. Independent Study. 3(0). Individual study and/or research in Operations Research, under the supervision of a faculty member. Final exam or final report. Offered by DFCS, DFEG, DFM, or DFMS. Prereq: department permission. Sem hrs: 3 fall or spring.

- Ops Rsch 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Ops Rsch 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.
- Ops Rsch 499C. Independent Study. 1(0). Sem hrs: 1 fall or spring.

PHILOSOPHY (Philos)

Offered by the Department of Philosophy (DFPY)

Philos 310. Ethics. 3(1)*. 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. Final exam. Prereq: None. Sem hrs: 3 fall or spring.

Philos 311. War, Morality, and the Military Profession. 3(1). An 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 Philos 310, or substitutes for Philos 310 (with department permission) if the student has independently studied ethical theory. Final exam or final project. Prereq: C1C, C2C, C3C standing and Philos 310. Sem hrs: 3 spring.

Philos 330. Introduction to the Philosophy of Science. 3(1). An 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. Final exam or final project. Prereq: Completed or enrolled in Philos 310 or department permission. Sem hrs: 3 spring.

Philos 360. Applied Reasoning. 3(1). An introduction to basic deductive and inductive applied logic. Includes an 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 will be expected to concentrate on reasoning in a specific field of interest. Final exam or final project. Prereq: C1C, C2C, or C3C standing. Sem hrs: 3 fall or spring.

Philos 370. Introduction to Symbolic Logic. 3(1). An advanced course in logic that examines propositional and predicate languages, model theory, quantifiers, proofs, identity theory and

properties of logical systems. Final exam or final project. Prereq: Completed or enrolled in Comp Sci 110. Sem hrs: 3 fall.

Philos 382. American Philosophy. 3(1). An 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, Dewey. Final exam or final project. Prereq: Completed or enrolled in Philos 310. Sem hrs: 3 fall.

Philos 390. Great Philosophers. 3(1). An in-depth study of some of the central Western philosophers and their systems of philosophy. Philosophers read will include some of the following: Plato, Aristotle, Augustine, Aquinas, Descartes, Locke, Berkeley, Leibniz, Hume, Kant, Hegel, Schopenhauer, and Nietzsche. Final exam or final project. Prereq: Completed or enrolled in Philos 310. Sem hrs: 3 fall or spring.

Philos 395. Philosophy of Law. 3(1). This course will serve as an introduction to legal philosophy and its relations to moral reasoning. Emphasis on 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. Final exam or final project. Prereq: Philos 310. Sem hrs: 3 spring.

Philos 401. Comparative Religion. 3(1). 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 this course include Hinduism, Buddhism, Islam, Judaism, and Christianity. See course syllabus for additional traditions to be examined in a given semester. Final exam or final project. No prereq. Sem hrs: 3 fall.

Philos 402. Philosophy of Religion. 3(1). Topics to be considered 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. Final exam or final project. No prereq, but students may find Philos 401 a helpful foundation. Sem hrs: 3 spring.

Philos 410. Medical Ethics. 3(1). Ethics applied to biomedical issues using a seminar approach. Ethical problems considered will 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. Final exam or final project. Prereq: Completed or enrolled in Philos 310. Sem hrs: 3 fall.

Philos 495. Seminar in Philosophy. 3(1). Selected topics in philosophy. Final exam or final project. Prereq: C1C or C2C standing. Sem hrs: 3 fall or spring.

Philos 499. Independent Study. 3(0). Philosophical research guided by an instructor. Topics and meetings arranged with the instructor. No final. Prereq: Department permission. Sem hrs: 3 fall or spring.

- Philos 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.

- Philos 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.

PHYSICAL EDUCATION (Phy Ed)
Offered by the Department of Physical Education under the Director of Athletics (AH).

Phy Ed 100. Basic Physical Training. 0(0). Preparation for strenuous physical education and athletics by development of physical strength, endurance, agility, and coordination through conditioning exercises, sports competition, and taking the Physical Fitness and Aerobics Test. Special training in conditioning as needed. Pass/Fail. Sem hrs: 0 summer.

Phy Ed 110. (Males Only). Boxing is taught to fourth class male cadets in order to develop an understanding of the physiological and psychological aspects of boxing. In addition to physical conditioning, boxing will also develop and intensify the military leadership attributes of quick reaction, coordination, accurate timing, cool judgment, aggressiveness, and determination. Boxing quickly acclimates the mind and body to adapt and overcome stress and fear which is a trait that is absolutely essential to fighting men. It teaches the ability to keep calm and poised under pressure, thus developing emotional control. This calmness under pressure can mean the difference between a right or wrong decision. The course includes 8 lessons of skills to develop self confidence, with safety, rules, and scoring emphasized prior to the graded review lessons. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 111. Swimming. Swimming is an individual sport that will teach cadets how to swim a variety of strokes and skills and to aid each cadet in learning to handle themselves in a swimming emergency. The class will provide sufficient aerobic and anaerobic activity and stroke skills so each individual is able to maintain and improve physical fitness in an aquatic environment as a cadet and officer. The students are graded on stroke skills, a timed 250 yard or meter swim, underwater swim, 5-meter scenario, treading water and drown proofing. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 112. Physical Development. The primary purpose of this course is to teach the cadet the basic information necessary to design effective training programs so that he or she can maintain a good level of fitness while a cadet, later as an officer, and throughout the lifespan. This class is also meant to provide the cadet the information necessary to perform at an acceptable level on the AFT and the PFT. Students are graded on a written exam (40 points), technique demonstrated on 8 exercises (40 points), an exercise log book (10 points), and 10 instructor points. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 114. Self Defense. (Females Only). Self defense is taught to all female fourth class cadets at the United States Air Force Academy in order to develop an understanding of the physiological and psychological aspects of self defense. In addition to the physical aspects of self defense, female cadets are lectured on the sexual awareness involved with rape and date rape. Female cadets are taught how to be aware of their environmental surroundings, avoid dangerous situations, and to be assertive if necessary due to an unwanted confrontation. The value of self defense is not only in the physical skills that are acquired, but the acclimation of the body and mind in adapting and overcoming a fearful and stressful situation. This course teaches the cadet to think and react under pressure and develops self confidence, courage, stamina and

agility, all necessary characteristics of a strong military presence. Cadets are taught how to fall to the ground in an attack situation or running from an assailant. Defensive techniques including kicking and striking are taught, as well as specific defenses against common attacks such as a one or two hand wrist grab, lapel grab, rear choke, rear bear hug, rear hammerlock and full nelson. Final Exam. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 115. Wrestling (Males Only). An introduction to the sport of wrestling designed to give students confidence by teaching the body mechanics required to maintain balance, leverage, and superior position through wrestling techniques. Includes live wrestling, basic technique demonstration and practice of takedowns, reversals, escapes, and pin-holds required to have a working knowledge of the sport of wrestling. Also includes explanation of the rules and the historical foundation of the sport. Emphasizes the need for fitness, being able to think and react quickly under pressure and the importance of developing mental and physical toughness required of warriors in the Armed Forces. Final exam. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 119. Basic Swimming I. This course is designed for cadets with little exposure to aquatics or those needing work on specific swimming endurance. Because these cadets typically need more time to acclimate to swimming, the course is 16 lessons. Entry into the class is determined by the 250 swim time and input from aquatics instructors. The first eight lessons focus largely on technique. The final eight lessons focus on building swimming endurance with continued work on technique. Cadets will be introduced to survival skills in preparation for the 200 level aquatics course. Cadets are encouraged to move on to regular water survival. However, more typically, they move on to Basic Water Survival for their 200 level aquatics. Replaces Phy Ed 111. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 152. Intercollegiate Sports. .05(2xx) fall or spring.

Phy Ed 211. Basic Water Survival. This course continues the development of the basic swimmer and teaches cadets basic aquatic survival skills that last a lifetime. These survival methods serve officers well throughout their careers. The class provides sufficient aerobic and anaerobic activities that challenge the cadets to maintain an above average level of fitness while having fun through aquatics. Cadets learn to save their own lives and assist others in a water emergency, survive in the water for long periods of time, and build confidence to swim long distances. Moreover, cadets experience situations that develop self-confidence, emotional control, persistence and courage. A variety of skills challenge cadets to move beyond their current skill and comfort levels. Cadets are evaluated in each one of the skills taught throughout the course. Replaces Phy Ed 222. Final exam. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 215. Unarmed Combat I. Introduction to students in basic self defense. Students are taught a combination of karate, aikido, and judo techniques to be used in attack situations. Students are taught to defend themselves from a standing position incorporating hand strikes, kicks, and throws. Students are put in pressure situations to apply class techniques to defend themselves. Students are tested in an attack situation to evaluate their ability to protect themselves. Final exam. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 219. Basic Swimming II. Replaces Phy Ed 222. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 222. Water Survival. An introduction to basic personal water survival skills and lifesaving techniques. The primary objective of the course is to learn personal water survival skills that are needed in a water emergency. A secondary objective is to learn basic lifesaving skills needed to assist someone else involved in a water emergency. Work to increase cardiovascular and muscular endurance is also part of the course. Prereq: Phy Ed 111 or 119. Final exam. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 252. Intercollegiate Sports. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 315. Unarmed Combat II. An introduction to basic unarmed offensive and defensive, grappling, choking, and joint locking skills. Includes live contact combative grappling designed to instill confidence, the ability to think and react quickly under pressure, and the ability to defend oneself in a hand-to-hand combat situation. Students will be expected to demonstrate the aggressive mind set, mental toughness and warrior spirit required to survive and prevail in an unarmed combat situation. Final exam. Prereq: Phy Ed 215. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 340. Racquetball. This class is designed to introduce the cadets to the essential fundamentals of racquetball including the introductory skills and rules of the game. This class offers the opportunity for students to develop a lifetime sport that can be used to stay physically fit and provides a recreational sport to play during intramural competition and throughout their Air Force career. This is a fun and exciting class for the cadets through athletics. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 341. Tennis. Tennis is an individual sport that teaches cadets the fundamentals of tennis so that they will achieve sufficient skills to participate in a game while a cadet, later as an officer, and throughout their life. Cadets will learn and be tested on the forehand, backhand, and the serve. Their physical fitness will be maintained and improved through drills and match play. Single match play will also be evaluated and graded. Each cadet will learn enough about the game so that he or she will have a newfound appreciation for the sport and be able to appreciate the game. Final exam. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 342. Golf. An introduction to the sport of golf designed to give students confidence by teaching the mechanics required to maintain proper hand-eye coordination through repetitive drill techniques. Emphasis is placed on skills improvement and understanding a respect for the game of golf, its traditions, rules, and etiquette. Basic golf swing technique demonstration and practice of putting, short irons, long irons, proper setup, and grip make up the foundation of the course. Emphasizes the need for practice discipline and mental concentration. One written exam, one performance exam. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 352. Intercollegiate Sports. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 440. Exercise Physiology. 3(2). Exercise physiology is the study of body functions before, during, and after an exercise session. This class also looks at the short-term and long-term changes that result from exercise training. Includes both academic classes and laboratory

experiences where the students learn about their body composition, strength, anaerobic power, and aerobic capacity. Prereq: Course Director permission. Sem hrs: 3 fall.

Phy Ed 452. Intercollegiate Sports. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 460. The Art and Science of Coaching. 3(1). An integrated course – applying organizational management, sports law, leadership and motivation, sports psychology, ethics and philosophy, exercise physiology, nutrition, and physical principles of motion to the world of college coaching. Independent research. Final paper. Prereq: First-class standing with Course Director permission. Sem hrs: 3 spring.

Phy Ed 477. Independent Exercise. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 479. Cadet Instructor. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 483. Scuba: SCUBA offers unique activities cadets have rarely experienced prior to attending the Academy. As individuals and "buddy teams", cadets will be exposed to both physical and mental challenges while being sustained underwater by a life support system. The skills mastered in this course will remove any pre-conceived fears of the water. This course will instill a more sound confidence level in future warrior officers and leaders. Upon completion, cadets can pursue their SCUBA activities as a Certified Open water SCUBA diver. SCUBA is a life long activity that can be utilized wherever there is a body of water. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 484. Volleyball. Volleyball is a lifetime team sport that teaches cadets the fundamentals of volleyball so that they will achieve sufficient skills to participate in a game while a cadet, later as an officer, and throughout their life. The class provides a history of volleyball, instruction on rules and theory, as well as basic, intermediate, and advanced technical skill development. Each cadet will learn enough about the game so that he or she can appreciate volleyball at the college and professional level. The students are graded on a skills test to include underhand and overhand passing, serving, setting and attacking, as well as a play evaluation in scrimmages grading the cadet's ability, attitude, and effort. Final exam. Sem hrs: 0.5 (2xx) fall or spring.

Phy Ed 486. Basketball. An introduction to the sport of basketball designed to broaden each player's understanding, knowledge, and appreciation for the game. Includes instruction in fundamental skills and basic drills each player can use for further skill development. Areas covered include passing, ball handling, shooting, individual offense, individual defense, rebounding, screens, team offense, team defense, and transition. The course provides maximum time for players to compete on the court. Emphasizes skill development and teamwork. Play evaluation. Sem hrs: 0.5(2xx) fall or spring.

Phy Ed 487. Soccer. Soccer is a lifetime team sport that teaches cadets the fundamentals of soccer so that they will achieve sufficient skills to participate in a game while a cadet, later as an officer, and throughout their life. The class provides sufficient aerobic and anaerobic activity so that each cadet's physical fitness will be maintained or improved, while having fun through athletics. Each cadet will learn enough about the game so that he or she can appreciate soccer at

the college and professional level. The students are graded on rules of the game (written 20 question test), a skills test to include juggling, dribbling, passing, and shooting, and play evaluation in scrimmages grading the cadet's ability, attitude, and effort. Final exam. Sem hrs: 0.5 (2xx) fall or spring.

Phy Ed 488. Softball. Softball is a team sport that teaches cadets the fundamental skills required to play the game while a cadet, later as an officer, and throughout their life. Cadets will learn both the fundamental skills it takes to be successful in the sport, and the rules by which the game is governed. Students will learn the mechanics for throwing, hitting, fielding, and base-running, and will be evaluated on their progression throughout the class. Teaches the relationship between individual performance and overall team success through teambuilding and leadership opportunities. Sem hrs: 0.5 (2xx) fall or spring.

Phy Ed 499. Independent Study. 3(0). Individual research and study in the physical education field under the direction of a faculty member. Emphasizes the use of laboratory facilities. No final. Research report. Prereq: Course Director permission and Department Head approval. Sem hrs: 3 fall or spring.

- Phy Ed 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Phy Ed 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.
- Phy Ed 499C. Independent Study. 1(0). Sem hrs: 1 fall or spring.

PHYSICS (Physics)

Offered by the Department of Physics (DFP)

Physics 110. General Physics I. 3(2)*. Introductory calculus-based physics course with emphasis on contemporary applications (first semester). Topics include Newtonian mechanics; conservation of energy, momentum and angular momentum; oscillations and waves; and special relativity. Emphasizes the use of vectors and calculus in problem solving. Course includes in-class laboratories and computer applications to highlight key concepts. Final exam. Prereq: Completed or enrolled in Math 142. Sem hrs: 3 fall or spring.

Physics 215. General Physics II. 3(2)*. Introductory calculus-based physics course with emphasis on contemporary applications (second semester). Topics include electrostatics, simple DC circuits, magnetic fields, electromagnetic induction, electromagnetic waves, physical optics, and selected topics in modern physics. Uses vectors and calculus in problem solving. Course includes in-class laboratories and computer applications to highlight key concepts. Course must be taken in the semester immediately following the successful completion of Physics 110. Final exam. Prereq: Physics 110 and Math 142. Sem hrs: 3 fall or spring.

Physics 264. Modern Physics. 3 (1). 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. Final Exam. Prereq: Physics 215 or department permission. Coreq: Math 243 (or Math 253). Sem hrs: 3 fall or spring.

Physics 310. Principles of Nuclear Engineering. 3(1). A survey course in the aerospace uses of nuclear energy. This 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. Final exam. Prereq: Physics 215 or department permission. Sem hrs: 3 spring.

Physics 315: Combat Aviation Physics. 3(1). A broad-based study of the principles of physics as they directly apply to the realm of combat aviation. The course covers two 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; and the combat use of the electromagnetic spectrum, primarily as it applies to radar, IR seekers, and countermeasures. Final exam. Prereq: Physics 215 or department permission. Sem hrs: 3 spring.

Physics 341. Laboratory Techniques. 3(2). An introductory laboratory course developing skills in experimental techniques and data analysis. Course includes instruction in the use of 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. Coreq: Physics 264 or department permission. Sem hrs: 3 fall or spring.

Physics 355. Classical Mechanics. 3(1). An 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. Final exam. Prereq: Physics 215; completed or enrolled in Math 346 or department permission. Sem hrs: 3 fall.

Physics 356. Computational Physics. 3(1). An 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. Final Exam or Final Project. Prereq: Physics 355. Sem hrs: 3 spring.

Physics 361. Electromagnetic Theory I. 3(1). 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. Final exam. Prereq: Physics 215. Coreq: Math 346 or department permission. Sem hrs: 3 fall.

Physics 362. Electromagnetic Theory II. 3(1). Applications 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. Final exam. Prereq: Physics 361. Sem hrs: 3 spring.

Physics 370. Upper Atmospheric and Geo-Space Physics. 3(1). A survey course on the composition and physics of the upper atmosphere and the 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. Final exam. Prereq: Physics 215 or department permission. Sem hrs: 3 spring.

Physics 371. Astronomy. 3(1). A calculus-based study of the fundamental concepts of astronomy. Emphasis is placed on 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. Final exam. Prereq: Physics 215 or department permission. Sem hrs: 3 fall.

Physics 391. Introduction to Optics and Lasers. 3(1). A 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). Final Exam. Prereq: Physics 215. Coreq: Math 245 or department permission. Sem hrs: 3 fall.

Physics 393. Solid State Physics. 3(1). 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, semi-conductors and insulators. Survey topics include magnetism, superconductivity, optical phenomena in solids, crystal imperfections and the physics of solid state devices. Final exam. Prereq: Physics 215. Coreq: Math 245 or department permission. Sem hrs: 3 fall.

Physics 405. First-Class Seminar. 0(1). A problem solving course reviewing major areas of undergraduate physics. Pass/Fail. Prereq: First-class Physics major or department permission. Sem hrs: 0 fall.

Physics 421. Thermal and Statistical Physics. 3(1). 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. Final exam. Prereq: Math 356, Math 300, or Math 377. Coreq: Physics 465, Chem 336, or department permission. Sem hrs: 3 fall.

Physics 442. Advanced Physics Lab. 3 (2). A series of selected experiments to develop the student's laboratory skills and reinforce basic physical concepts. Possible topics covered include atomic and molecular physics, gamma ray spectroscopy, laser physics, proton-induced elementary nuclear reactions, x-ray crystallography, optical interferometry and holography, and nonlinear optical processes. The experiments are performed by small groups of students working

as teams. Emphasis on the ability to write and brief technical subjects to a technical audience. Prereq: Physics 341 and Physics 264, or department permission. Sem hrs: 3 fall or spring.

Physics 451. Plasma Physics. 3(1). 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. Final exam. Prereq: Physics 362 or department permission; completed or enrolled in Math 346. Sem hrs: 3 fall.

Physics 453. Solar-Planetary Interactions. 3(1). Discussion of the basic physical principles controlling the sun's interaction with planetary atmospheres. Topics include the dynamics and structure of the solar atmosphere, origin of the solar wind and the interaction of the solar wind with space vehicles, Earth-based systems and the Earth's plasma environment. Quantitative descriptions of electric currents and fields, and auroral and atmospheric dynamics will be introduced. Final Exam. Prereq: Physics 451 or department permission. Sem hrs: 3 spring.

Physics 465. Quantum Mechanics. 3(1). 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. Final exam. Prereq: Physics 264 and Math 346, or department permission. Sem hrs: 3 fall.

Physics 468. Atomic and Nuclear Physics 3(1). 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, atomic and molecular spectroscopy techniques. Final exam. Prereq: Physics 465 or department permission. Sem hrs: 3 spring.

Physics 480. Astronomical Techniques. 3(2). Introduction to optical astronomy using the USAFA 24" and 16" telescopes during 9 scheduled night laboratories. Emphasis on equipment operating principles, scientific method, data reduction and reporting results. Includes astrophotography, photoelectric photometry, charge coupled devices and spectroscopy. Final exam or final project. Prereq: Physics 341 and Physics 371, or department permission. This course has limited enrollment; all registrations must have department approval. Sem hrs: 3 fall or spring.

Physics 482. Laser Physics and Modern Optics. 3(1). A 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. Final exam. Prereq: Physics 362, El Engr 444, or department permission. Sem hrs: 3 spring.

Physics 486. Astrophysics. 3(1). Application 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. Final exam. Prereq: Physics 264 and Physics 362, or department permission. Sem hrs: 3 spring.

Physics 495. Special Topics. 3(1). Selected topics in physics. Final exam or final report. Prereq: Department permission. Sem hrs: 3. Offering time determined by department.

Physics 499. Independent Study. 3(0). Individual research under the direction of a faculty member. Final report. Prereq: Department permission. Sem hrs: 3 fall or spring.

- Physics 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Physics 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.
- Physics 499C. Independent Study. 1(0). Sem hrs: 1 fall or spring.

POLITICAL SCIENCE (Pol Sci)

Offered by the Department of Political Science (DFPS)

Pol Sci 300. Introduction to Political Science: Overview and Methods. 3(1). Provides an introduction to the discipline. The course introduces students to the methods used in the political science, placing emphasis on 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. The research approaches presented in this class are essential to the political science major, and of great benefit to cadets in other majors that require the systematic examination of research questions. Final exam or research paper. Prereq: Pol Sci 311. Sem hrs: 3 fall.

Pol Sci 301. Political Theory. 3(1). Provides 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. The course's examination of the debates about human nature, the best regime, justice, equality, freedom, community, natural rights, and between religion and comparative and national security politics provide an essential foundation for the political science major and are invaluable for any airman-scholar. Final exam or research paper. Prereq: Pol Sci 311. Sem hrs: 3 fall.

Pol Sci 311. Politics, American Government and National Security. 3(1). This course 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 will examine current policy issues that affect the military. Final exam. Sem hrs: 3 fall or spring.

Pol Sci 390. International Relations Theory. 3(1). Introduces the basic concepts of international relations. Major theoretical approaches to the analysis of international politics (realism, liberalism, and globalism) will be 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. Final exam or research paper. Prereq: Soc Sci 112. Sem hrs: 3 spring.

Pol Sci 392. American Political System and Theory. 3(1). Explores the origin and development of American political ideas and institutions. This course 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. Final exam or research paper. Prereq: Pol Sci 311. Sem hrs: 3 spring.

Pol Sci 394. Comparative Government and Politics. 3(1). 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. Final exam or research paper. Prereq: Soc Sci 112. Sem hrs: 3 spring.

Pol Sci 396. US Foreign and National Security Policy. 3(1). Identifies and examines the dominant themes in US foreign and national security policy from the post-WWII period. Analyzes the relationship between values and interests in the development and execution of US foreign/national security policy towards allies and adversaries. Studies the problems associated with diplomatic, economic, and military instruments of power and the effects of the pluralistic decision-making process during the post-Cold War era. Includes an examination of the formulation of US national strategy, resource allocation, and force planning debates. Final exam or research paper. Sem hrs: 3 fall.

Pol Sci 421. International Security: Political Violence and Terrorism. 3(1). 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 non-state 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. Final exam or research paper. Prereq: Soc Sci 112 and Pol Sci 311. Sem hrs: 3 spring.

Pol Sci 423. War Crimes, Genocide, and Human Rights. 3(1). This course 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. The 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. Final Exam or research paper. Prereq: Soc Sci 112. Sem hrs: 3 fall.

Pol Sci 444. International Political Economy. 3(1). This course will explore 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 will 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. Final exam or research paper. Prereq: None. Sem hrs: 3 spring.

Pol Sci 445. International Organizations and Global Issues. 3(1). Examines the role and interrelationship of international organizations, nation-states, and non-state 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. Final exam or research paper. Prereq: Soc Sci 112. Sem hrs: 3 fall.

Pol Sci 451. American Political Thought. 3(1). A survey of 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. The focus is on the difficulties of translating principles into practice. Final exam or research paper. Prereq: Pol Sci 311. Sem hrs: 3 fall of odd-numbered years.

Pol Sci 460. Comparative Security Policy and Civil-Military Relations. 3(1). Studies the security policies and policy-making processes of various world regions as well as the national and regional implications of both traditional and non-traditional security issues. Examines 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. Final exam or research paper. Prereq: Soc Sci 112. Sem hrs: 3 spring.

Pol Sci 462. Politics and Intelligence. 3(1). Explores the character of secrecy in the American democratic system. This course investigates the role of intelligence in the development and implementation of US 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 issue in the intelligence field. Final exam or research paper. Prereq: Pol Sci 311. Sem hrs: 3 fall

Pol Sci 465. US National Space Policy and Law. 3(1). Examines the evolution, major influences on, and consequences of US national space policy and space law. 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. Final exam, research paper or project. Coreq: Soc Sci 112. Administered by DFPS and DFL. Sem hrs: 3 fall.

Pol Sci 469. Politics of Russia and Newly Independent States. 3(1). 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 political-economic reforms, with a particular emphasis on security concerns. Final exam or research paper. Prereq: Soc Sci 112. Sem hrs: 3 fall.

Pol Sci 471. Politics of Europe. 3(1). 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. Final exam or research paper. Prereq: Soc Sci 112. Sem hrs: 3 fall.

Pol Sci 473. Politics of Asia. 3(1). 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. Final exam or research paper. Prereq: Soc Sci 112. Sem hrs: 3 fall.

Pol Sci 475. Politics of Latin America. 3(1). 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. Final exam or research paper. Prereq: Soc Sci 112. Sem hrs: 3 fall.

Pol Sci 477. Politics of the Middle East. 3(1). 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. Final exam or research paper. Prereq: Soc Sci 112. Sem hrs: 3 fall.

Pol Sci 479. Politics of Sub-Saharan Africa. 3(1). 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. Final exam or research paper. Prereq: Soc Sci 112. Sem hrs: 3 fall of even-numbered years.

Pol Sci 481. American Elections and Political Parties. 3(1). 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 fund raisers, and

media consultants in congressional and presidential campaigns. Special attention is given to the current presidential or congressional elections. Final exam or research paper. Prereq: Pol Sci 311. Sem hrs: 3 fall of even-numbered years.

Pol Sci 482. The U.S. Supreme Court. 3(1). 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. We will study the Court's rulings in these areas and many others, focusing on the Court's 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. Final exam or research paper. Prereq: Pol Sci 311. Sem hrs: 3 spring.

Pol Sci 483. The US Congress. 3(1). 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 the law making process. Final exam or research paper. Prereq: Pol Sci 311. Sem hrs: 3 fall.

Pol Sci 484. The American Presidency. 3(1). 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. Final exam or research paper. Prereq: Pol Sci 311. Sem hrs: 3 spring.

Pol Sci 485. Decision Making in Public Policy. 3(1). Examines the formulation and implementation of American public policy. Uses various theories and analytical models, including the bureaucratic politics, process, group. Rational, incremental, and public choice models, to describe and explain the causes and consequences of several key domestic public policy areas. Depending on contemporary significance, these may include civil rights, economic policy, education, environment, health and welfare, science and technology, and national defense. Final exam or final research paper. Sem hrs: 3 fall of odd-numbered years.

Pol Sci 491. Capstone Seminar in Political Science. 3(2). This course is the culmination of the political science curriculum. We begin with selections from classic works relevant to today's politics and political science, such as Thucydides, *The Federalist*, and Tocqueville's *Democracy in America.* These works synthesize theoretical and empirical study and instruct in the political judgment needed by political scientists, political actors and members of the profession of arms. We then turn to recent works on democracy and the many questions about it raised by the sub-fields of the department's curriculum--international relations, comparative politics, American politics, and national security. Students will be required to draw upon all the works in the seminar for a final presentation/paper related to a current issue. Final paper. Prereq: C1C Standing. Coreq: Pol Sci 390, 392, 394, or 396. Sem hrs: 3 spring.

Pol Sci 495. Special Topics in Political Science. 3(1). Selected topics in political science, taught in seminar format. One field trip per semester when appropriate local destinations are

available. Final exam or final report. Prereq: Soc Sci 112. Sem hrs: 3 fall or spring.

Pol Sci 496. The Politics of National Security Policy. 3(1). This seminar examines the theory and practices associated with national security policy. The course will include in-depth investigation of contemporary issues in the formulation of national security policy, e.g., budgeting, force planning, alliance relations and national security. Major models and theories of U.S. national security policymaking are analyzed so as to prepare students for a major research paper focusing on a significant national security issue. Research paper. Prereq: C1C standing, Soc Sci 112 and Pol Sci 396, or departmental approval. Sem hrs: 3 spring.

Pol Sci 498. First-Class Thesis. 3(1). Cadets enrolled in this course will prepare a 50-75 page First-Class thesis under the guidance of the course director and other faculty members with particular expertise on the topic of research. This course combines the tutorial aspect of an independent study (Pol Sci 499) with seminar on applied research methods. Cadets will meet individually or in seminar in accordance with a schedule determined by the course director. Formulation of thesis and research normally will begin in Political Science 300 and other political science courses. When the thesis has been completed, a formal defense will be given to a faculty committee in April or May. In preparation for the formal defense, each thesis will be presented to fellow cadets in the seminar for critique and evaluation. Research paper. Prereq: C1C standing and department permission. Sem hrs: 3 spring.

Pol Sci 499. Independent Study in Political Science. 3(0). Individual study or research of a carefully selected topic conducted on a tutorial basis. Research paper or a directed reading. Prereq: Soc Sci 112 and department permission. Sem hrs: 3 fall or spring.

- Pol Sci 499A. Independent Study. 2(0). Sem hrs: 2 fall or spring.
- Pol Sci 499B. Independent Study. 1.5(0). Sem hrs: 1.5 fall or spring.
- Pol Sci 499C. Independent Study. 1(0). Sem hrs: 1 fall or spring.

CADET PROFESSIONAL MILITARY EDUCATION (CPME)

Offered by the Commander, 34th Training Group (34 TRG)

PDP 100/101. Fourth-Class Professional Military Education. 0(1). Fall semester lessons concentrate on the knowledge required to orient cadets to Academy life. The first block of lessons focuses on the practical aspects of personal responsibilities, time management, and setting and attaining goals. Other lessons stress duty, followership skills, heritage and honor. During the spring semester, training focuses on the Academy Leadership Development Manual (LDM) and operational Air Force issues. These lessons help cadets better understand operational career fields, the enlisted force, and Air Force wing structure.

PDP 200/201. Third-Class Professional Military Education. 0(1). Fall semester lessons focus on gaining skills for teaching and instructing fourth-class cadets. Cadets learn how to properly apply the Academy Leadership Development Manual (LDM), including subordinate-leader training. The spring semester focuses on supervisory skills and military communication.

PDP 300/301. Second-Class Professional Military Education. 0(1). Second Class Professional Military Education focuses on development of supervisory skills. In the fall semester, cadets

analyze operational problems; prepare written corrective actions; and learn delegating, controlling and problem solving. Spring lessons concentrate on leadership principles. This approach permits cadets to practice and refine these leadership skills in preparation for leadership of the Cadet Wing and later for leadership in the Air Force as a commissioned officer. Lessons on Quality Air Force and organizational improvement prepare second-class cadets for their role as leaders in the Cadet Wing.

PDP 400/401. First-Class Professional Military Education. 0(1). The First Class Professional Military Education makes final preparations for commissioning. During their first-class year, cadets will apply leadership skills in running the Cadet Wing. They will also obtain a working knowledge of the Air Force to include such topics as officer standards, the assignment system, officer finances and the enlisted evaluation system.

SOCIAL SCIENCE (Soc Sci)

Offered by various departments within the Social Sciences Division

Soc Sci 112. Geopolitics. 3(1). This integrated interdisciplinary core course investigates the relationship between geographic and political factors. Through discussion of atmospheric, physiographic and cultural processes, it describes their impact on the physical and cultural foundations of the international system. It examines the fundamentals of international politics and how states and other actors seek to pursue their interests in that system. Final Exam. Sem hrs: 3 fall or spring.

Soc Sci 400. Social Sciences Seminar. 3(2). Interdisciplinary course. An interactive seminar focused on relevant social sciences topics. Final paper, report or exam. Administered by the Social Science Division Chairman. Sem hrs: 3 fall.

Soc Sci 401. Creativity. 3(1). This course uses a seminar format in an effort to develop a foundation for the understanding of creativity, to apply this foundation to the unique mission of USAFA and the military, and to enhance creativity for themselves and their subordinates. Students will gain an appreciation of the causes and potential consequences of creativity by studying the lives of creative individuals. Examining the biological, psychological, and social influences on creativity will help students understand how to cultivate creativity in a culture of conformity. Final project. Sem hrs: 3 spring.

Soc Sci 420. Law and Economics. 3(1). An interdisciplinary course which examines various legal issues from an economics perspective. The course employs basic economic principles in an effort to understand the nature of legal rules, their effect on society and to suggest how these rules might be reformed. This framework is applied to tort law, criminal law, contract and property law. Final exam or final paper. Prereq: Econ 200. Law 220 recommended. Administered by DFL and DFEG. Sem hrs: 3 spring.

Soc Sci 483. Principles of Negotiation and the Mediation Process. 3(1). A study of the process of negotiation in a variety of conflict situations, from negotiating with family members to international, multi-party disputes. The course focuses on an "interest-based" approach to negotiations to achieve effective, efficient and amicable agreements. Students will study a

model approach and will experiment with that approach in a number of simulated negotiations. Students will also learn the Air Force mediation process and practice using it. Final Report. Prereq: None. Offered by the Department of Law. Instruction shared by DFL, DFM, and DFBL. Sem hrs: 3 fall.

SPACE OPERATIONS (Space Ops)
Offered by the Department of Astronautics

Space Ops 360. Basic Space Operations. 3(1). Introduction to the principles, problems, and history of space operations. Elements of space operations are examined including operations management, planning, architecture, and execution. Ground station hardware, software, and communication principles are also explored. The course concludes with ground station qualification training and certification. The certification prepares the student at the entry level to support active satellites like FalconSAT missions, which are student-built satellites produced through the Astro 436/437 course sequence. Final exam. Prereq: Astro Engr 310. Sem hrs: 3 spring.

Space Ops 461. Intermediate Space Operations. 3(1). A second course in space operations. 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. Final exam. Prereq: Space Ops 360. Sem hrs: 3 fall.

Space Ops 462. Master of Space Operations. 3(1). A third course in space operations. Advanced topics in space operations are discussed, 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 Enginering II (Astro Engr 437) and with operators at Schriever AFB 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 Final exam. Prereq: Space Ops 461. Sem hrs: 3 spring.

STUDY SKILLS (Stdy Skls)
Offered by Student Academic Services (DFRL)

Study Skills 101. Strategies for Academic Success. 2(1). Focuses on time management, study strategies, reading enhancement, information and memory processing, and additional topics related to improved academic performance. Enrollment consists primarily of fourth-class cadets, meeting a full semester. Enrollees are granted two semester hours of credit. Although enrollees do not receive credit towards graduation, the course is intended to facilitate progress towards graduation. Pass/Fail. Prereq: None. Sem hrs: 2 fall.

Study Skills 102. Strategies for Academic Success (Abridged). 0.5(1x). This 15-lesson course teaches fundamental study strategies. Cadets will learn how to construct an efficient time management plan, take good notes, use effective listening skills, avoid procrastination, and read effectively. Course material is presented in a variety of modes, including tutorial software. Pass/Fail. Sem hrs: 0.5 fall or spring.

Reading Skills 103. Reading Enhancement for First-Year Cadets. 2(1x). Designed to enhance reading efficiency for a wide variety of reading tasks, to include reading for academic courses, professional development, critical thinking, and reading for pleasure. Special emphasis is placed on use of core academic course texts for first-year cadets. Overall course goals include increasing reading rate, comprehension, and recall abilities. Course will meet twenty-one lessons. When registering for this course, please specify preference for taking course during first-half (e.g., Reading Skills 103) or second-half of semester (e.g., Reading Skills 103X). Enrollees are granted two semester hours of credit. Although enrollees do not receive credit towards graduation, the course is intended to facilitate progress towards graduation. Pass/Fail. Prereq: None. Sem hrs: 2 fall or spring.

Reading Skills 201 or Reading Skills 201X. Reading Enhancement. 2(1x). Designed to enhance reading efficiency for a wide variety of reading tasks, to include reading for academic courses, professional development, critical thinking, and reading for pleasure. Overall course goals include increasing reading rate, comprehension, and recall abilities. Course will meet twenty-one lessons. When registering for this course, please specify preference for taking course during first-half (e.g., Reading Skills 201) or second-half of semester (e.g., Reading Skills 201X). Enrollees are granted two semester hours of credit. Although enrollees do not receive credit towards graduation, the course is intended to facilitate progress towards graduation. If you received credit for Reading Skills 103, Reading Enhancement for First-Year Cadets, you may NOT enroll in Reading Skills 201. Pass/Fail. Prereq: None. Sem hrs: 2 fall or spring.

SYSTEMS ENGINEERING (Sys Engr)

Sys Engr 290. Systems Engineering I. 3(2). This course presents an introduction to the systems engineering process and the development lifecycle as a foundation for solving complex problems to fulfill end user needs. Systems engineering topics include customer needs, technical requirements analysis, functional analysis, and creative design synthesis and selection across all eight primary system functions (development, manufacturing/production, verification, deployment, training, operations, support, and disposal). Planning, organizing, leading, and controlling a project throughout the phased program development lifecycle will also be addressed. Other topics include engineering ethics, engineering economics, technical communications, and Computer Aided Design (CAD). Cadets will apply the systems engineering process through the development, manufacture, and verification of several system prototypes. Final project. Prereq: Engr Mech 120. Sem hrs: 3 fall or spring.

Sys Engr 301. Systems Engineering II. 3(1). This course presents a more advanced study of the systems engineering process and development lifecycle, as a foundation for solving complex problems in the fulfillment of end user needs. Expanding on the basic topics of Sys Engr 290,

the course incorporates advanced analytical tools to help the students more thoroughly execute a complex project. These advanced tools include design optimization, modeling and simulation, decision analysis, risk management, information systems, evaluating development lifecycle approaches (e.g. spiral vs. waterfall vs. rapid prototyping), schedule preparation and analysis, life cycle cost, earned value, logistics, and testing methodologies. Cadets will apply these advanced tools through case studies and analysis of capstone design projects. Final examination. Prereq: Sys Engr 290. Sem hrs: 3 spring.

Sys Engr 405. Systems Engineering Seminar I. 0(1). A seminar course designed to help integrate Sys Engr and Sys Eng Mgt majors into the capstone design course sequence and share knowledge across the various capstone design projects. The seminar course is also designed to help transition Sys Engr and Sys Eng Mgt majors from their undergraduate education to duties as an AF officer and systems engineering professional. Seminar topics include current Sys Engr and Sys Eng Mgt literature and tools used to manage large complex systems and integrate the many subsystems that comprise the larger systems, engineering ethics, and typical engineering and management problems which cadets may encounter during their capstone design experience and after graduation. Invited speakers will offer their view of what it takes to be successful in the AF. The course will meet up to once per week. Prereq: 1° Sys Engr and Sys Eng Mgt majors. Pass/fail. Sem hrs: 0 fall.

Sys Engr 406. Systems Engineering Seminar I. 0(1). A seminar course designed to help integrate Sys Engr and Sys Eng Mgt majors into the capstone design course sequence and share knowledge across the various capstone design projects. The seminar course is also designed to help transition Sys Engr and Sys Eng Mgt majors from their undergraduate education to duties as an AF officer and systems engineering professional. Seminar topics include current Sys Engr and Sys Eng Mgt literature and tools used to manage large complex systems and integrate the many subsystems that comprise the larger systems, engineering ethics, and typical engineering and management problems which cadets may encounter during their capstone design experience and after graduation. Invited speakers will offer their view of what it takes to be successful in the AF. The course will meet up to once per week. Prereq: 1° Sys Engr and Sys Eng Mgt majors. Pass/fail. Sem hrs: 0 spring.

Sys Engr 472. Cognitive Systems Engineering. 3(1). Survey of systems processes applied to the cognitive engineering of complex socio-technical systems. Methodologies are examined for the acquisition and translation of expert user knowledge into designs of decision aiding automated systems and for the derivation of system information requirements / human decision making requirements. Focus on the design of system solutions and functional system interfaces that meet users'/operators' needs and capabilities in the cognitive and decision making domains. Particular consideration is given to military applications in the C4ISR scenario. Prereq: Beh Sci 471. Final exam/project. Sem hrs: 3 spring.

Sys Engr 491. Systems Engineering Capstone Design I. 3(0). Capstone design experience for Sys Engr majors. Emphasis placed on execution of the systems engineering process over the entire development lifecycle of a complex system. Generally, students will fulfill the systems engineering and systems engineering management roles on existing capstone design projects in various departments. Students will apply the systems engineering tools acquired in their

previous systems engineering and systems engineering management coursework. Final project. Prereq: C1C in good standing in Sys Engr or Sys Eng Mgt major, Sys Engr 290, and Sys Engr 301. Sem hrs: 3 fall.

Sys Engr 492. Systems Engineering Capstone Design II. 3(0). Continuation of Sys Engr 491. Final project . Prereq: Sys Engr 491. Sem hrs: 3 spring.

Sys Engr 495. Special Topics in Systems Engineering. 3(1). Selected topics in systems engineering. Final exam or final report. Prereq: Sys Engr or Sys Engr Mgt AIC permission. Sem hrs: 3 fall or spring.

SYSTEMS ENGINEERING MANAGEMENT (Sys Engr Mgt)

Sys Engr Mgt 495. Special Topics in Systems Engineering Management. 1-3(1). Selected topics in systems engineering management. Final exam or final report. Prereq: department permission. Sem hrs: 1-3 fall or spring.

CHAPTER 12

DEFINITION OF TERMS

ACADEMIC COURSE: A graded course yielding college credit, usually under the supervision of the Dean of the Faculty; however, the 34th Training Wing (34 TRW) and AH also supervise a few academic courses. The 34 TRW/CC (Commandant of Cadets) supervises Aviation, Airmanship and MSS academic courses. The Director of Athletics oversees Phy Ed academic courses.

ACADEMIC DAY: There are 84 academic days in a semester, divided equally as "M" or "T" days. Each day consists of seven 50-minute class periods. Academic Call to Quarters (ACQ), as listed in the current Cadet Wing Schedule of Calls, is also considered part of the academic day.

ACADEMIC DIVISION OPTION: Any graded course taught for credit under the supervision of the Dean of the Faculty or the Director of Athletic. Courses must carry at least three semester hours of credit and be graded. The courses include the course offerings of the Basic Sciences, Engineering, Social Sciences, and Humanities divisions. The basic courses, Math 130, English 109 and English 110 do not normally fulfill this requirement. These courses may be included at the discretion of the Division Chair (Divisional Major) or Department Head (Disciplinary/Interdisciplinary Major).

ACADEMY OPTION: Any course taught for credit under the supervision of the Dean of the Faculty, 34 TRW/CC, or the Director of Athletics. Courses must carry at least three semester hours of credit. Academy Options may include Math 130, English 110, Armnshp 425, Armnshp 461, Armnshp 492, or any three semester hour non-core course. Each major (divisional, disciplinary, and interdisciplinary) will have one Academy Option.

ADVANCED COURSE: An academic course of similar content to another course, but covers material in significantly greater depth (e.g., Math 356 is an advanced alternate for Math 300).

ALTERNATE COURSE: Any course taken in place of another course to fill the core or major's requirements for that course (see Chapter 7 for details).

COMMON GRADED REVIEW: Common GR (see Graded Review for details). A graded review given at one time for all students in a course, most commonly administered during the Common GR Period from 0630 – 0720.

CONCURRENT: See Corequisite.

CONDITIONAL TURNBACK: A cadet who has experienced severe academic difficulties and will probably require a ninth semester in residence to meet graduation requirements. The Academy Board makes the designation on an individual basis. A cadet in conditional turnback status must graduate with a divisional major or in the Bachelor of Science Program and be minimally loaded each semester. A cadet in conditional turnback status who earns at least a 2.40

cumulative or semester grade point average may take a sixth course as an overload during the next semester. Cadets will remain in conditional turnback status until they graduate, unless they fail to meet graduation requirements by the end of the calendar year in which their original class graduated. At that time, the Academy Board will transfer them to the next succeeding class, and they will be designated as turnbacks. Cadets may petition to be removed from conditional turnback status by submitting a formal letter of request to the appropriate Academic Review Committee chairman.

CORE COURSE: A course all cadets must take for graduation. Advanced courses, honors courses, or validation/transfer credit may fill core requirements (see Chapter 7 for details).

CO-REQUISITE: Course may be taken at the same time with, but no later than, another.

COURSE: A body of instruction in the USAFA curriculum. Courses may be academic or non-academic, graded or non-graded, core or major, advanced, audited, repeat, continuing, alternate or overload.

DELAYED COURSE: A core course taken in a later semester than found in the normal sequence for the particular class. Authorization to delay a core course must be approved by the appropriate department head. Delayed courses must be taken in the semester approved by the department head (see Chapter 7, Core Sequences).

DISCIPLINARY MAJOR: A major with a specific area of concentration which requires 42-52 semester hours beyond the core. Refer to Chapter 10 for requirements of offered majors.

DIVISIONAL MAJOR: A major with a general area of concentration which requires 36 semester hours beyond the core. Refer to Chapter 9 for requirements of individual majors.

ELECTIVE COURSE: Any course a cadet elects to take beyond the mandatory core curriculum.

FINAL EXAMINATION: An evaluation covering an entire course. It requires two or more hours to complete and counts for at least 25% of the course grade. See the course description portion of this handbook to find out which courses require a final examination. Unless waived by the Vice Dean, courses listing a final examination must have an in-class examination during the final examination periods. NOTE: Cadets who resign at the end of semester will receive course credit only if all finals are completed.

GRADED COURSE: A course for which a grade of A, A-, B+, B, B-, C+, C, C- or D is awarded upon successful completion. Grades of F (failing), W (withdrawn), WP (withdrawn passing), WF (withdrawn failing), and I (incomplete) may also be awarded at the end of a graded course. An N grade may be awarded to reflect no grade available for a continuing graded course. For more information, see Chapter 4.

GRADED REVIEW (GR): An evaluation covering material taught during several periods of instruction. It carries weight equal to two or more quizzes. The extent of the material and the approximate weight assigned to each GR are announced before the examination. If cadets are

scheduled for more than two GRs on the same day, they may complete the additional GR(s) during free periods on the opposite day of the same lesson number with appropriate department head approval. See USAFAI 36-183, Evaluation and Distribution of Cadet Grades.

GRADUATION (ON TIME): Graduating in eight (8) semesters with the cadet's incoming class. This graduation ceremony occurs in May/June of each year. Cadets must graduate on time, even if it means dropping their major from disciplinary to divisional. Only the USAF Academy Board may make a cadet a late graduate (see Late Graduation for further explanation).

LATE GRADUATION: Graduating after the May/June ceremony held for the cadet's incoming class. Late graduation occurs at the end of the summer term and in December. Only the USAF Academy Board may make a cadet a late graduate.

MAJOR'S COURSE: A course taken to satisfy the requirements for an academic major.

NON-GRADED COURSE: A course for which a grade of P (passing) is awarded upon successful completion. Grades of F (failing), W (withdrawn), WP (withdrawn passing), WF (withdrawn failing), and I (incomplete) may also be awarded at the termination of a non-graded course. An N grade may be given in continuing courses. N grades may also be given in Mil Tang 100 (BCT) and Mil Tang 220 (CST) when cadets are physically unable to complete one or more phases of the program. A non-graded course may also be designated a pass-fail course.

NORMAL COURSE LOAD: The number of semester hours of academic courses and/or non-academic courses which a cadet may take without regard to grade point average. For further information see Section I, Chapter 2.

OVERLOAD: Overloads are courses taken in excess of the normal course load. Cadets fulfilling overload requirements may take an overload after their first year at USAFA. For specific course load information, see Chapter 2.

PASS-FAIL COURSE: See Non-Graded Course.

PREREQUISITE: A course which serves as a foundation for another course and is therefore required to be taken in an earlier semester.

QUIZ: An evaluation which covers material taught in a small unit of instruction. Normally, it requires less than half of one class period to complete. Quizzes may be one of two types: (1) departmental quizzes, designed by a committee or the course director and administered to all cadets meeting the course on the same day, or (2) instructor quizzes, designed by the individual instructor and administered at the instructor's discretion during any class meeting not scheduled for a departmental quiz or graded review.

SPECIAL TOPICS COURSE: Each academic discipline may offer an academic course with the content varying semester to semester, based on cadet or department desires and needs. Such a course is designated "--------495. Special Topics." In late spring, the editor of the *Curriculum Handbook Supplement* publishes a complete listing and description of all special topics courses

for the upcoming fall semester. Spring offerings are published in late fall.

SUMMER ACADEMIC COURSES: Cadets may volunteer or be directed by an Academic Review Committee to take an academic course in lieu of summer leave. Registration for summer academics is in February and March of each year.

TRANSFER CREDIT: Credit given for college-level courses equivalent to Academy courses but taken at another accredited college, university, or secondary school. A cadet must request this credit and submit a transcript. Transfer credit standards are the following:

a. A grade of "B" or higher is generally required for transfer credit for any course in the curriculum.
b. A grade of "C" or higher is acceptable for transfer credit for any terminal course which is not a prerequisite for other courses in the curriculum.
c. Departments giving mandatory placement examinations to the incoming fourth class may give transfer credit for core courses when the combination of scores on entrance or placement examination and prior course work is justified even though the course grade is below "B". A department head may ask the Dean of the Faculty to request the Registrar to withdraw transfer credit. All transfer/validation credits may be applied toward graduation requirements; however, at least 132 semester hours must be taken at USAFA (or USAFA-sponsored exchange programs) to meet minimum requirements. Transfer/validation credit is coordinated with academic departments by DFRR.

TURNBACK: A cadet who has been transferred from one class to the next succeeding class (e.g., medical, administrative). If a cadet in deferred turnback status fails to meet graduation requirements by the end of the calendar year in which the cadet's original class graduates, the Academy Board will transfer the cadet to the next succeeding class and the cadet will be designated as a turnback.

UNDERLOAD: A course load less than minimum requirements reflected in Chapter 2.

VALIDATION CREDIT: Credit given for passing a validation examination or as a result of completing an accelerated or advanced course. A cadet who has passed college-level courses for which transfer credit is not awarded or who has extensive knowledge of a subject acquired without a formal course may be able to pass a validation examination. Validation examinations for fourth-class core courses are usually scheduled in the summer. For other courses, a cadet petitions the appropriate department and may be given an examination if the cadet can furnish evidence to indicate that he/she has a reasonable chance of passing. Occasionally, an academic department may invite a cadet to take the examination. A cadet who passes a validation examination or who makes an acceptable score on a College Board Advanced Placement examination may also earn validation credit. Departments certify this credit to the Office of Registrar, Customer Service and Academic Scheduling (DFRR). The various academic departments may award validation credit in any academic course (excluding Special Topics and Independent Studies courses). Except for core courses, validation credit may not be awarded later than a cadet's sixth semester. No cadet may be given validation credit for a course after attending any class meetings for the same course without expressed approval of the Dean of the

Faculty. All transfer and validation credits may be applied toward graduation requirements; however, at least 132 semester hours must be taken at USAFA (or USAFA-sponsored exchange programs) to meet minimum residency requirements.

WACQ: A WACQ (Weekend Academic Call to Quarters) is a 60-minute period of study, served during the weekend, assigned to an academically-deficient cadet.

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