PENNSTATE

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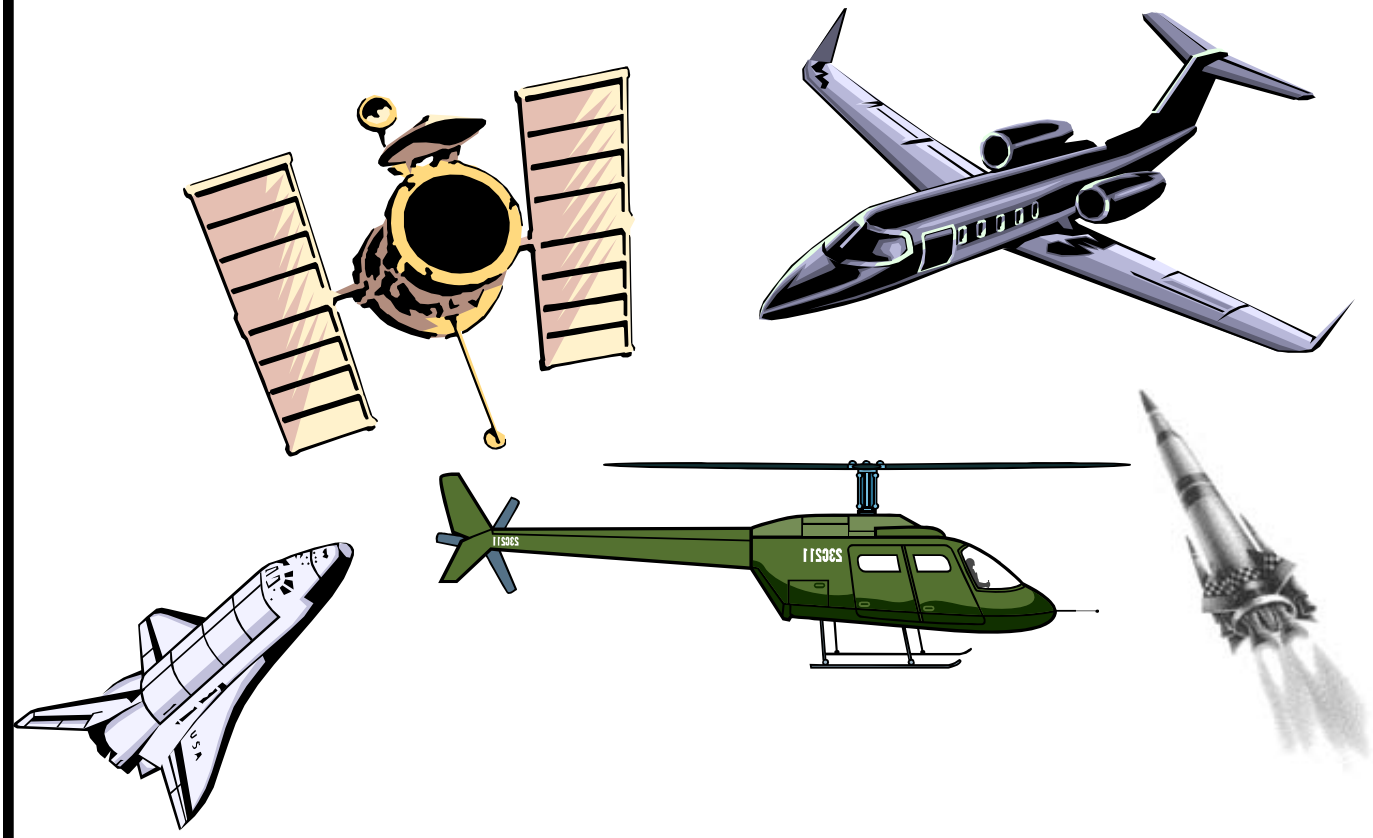
Department of Aerospace Engineering



Undergraduate Curriculum Guide

www.aero.psu.edu

2009-2010

Forty-Fourth Edition

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COURSE NUMBER CHANGES

OLD	NEW
Chem 12	Chem 110
CmpSc 201C	CmpSc 201
CmpSc 201F	CmpSc 202
ED&G 100	EDSGN 100
EE 305	EE 212
EMch 11	EMch 211
EMch 12	EMch 212
EMch 13	EMch 213
EMch 13D	EMch 213D
EMch 215	EMch 315
EMch 216	EMch 316
ME 23	ME 201
ME 30	ME 300

These changes were made during the 2007-08 academic year. The Degree Audit system was updated to recognize both the old and new course numbers.

INTRODUCTION

The purpose of this handbook is to:

1. Familiarize students and visitors with the Penn State Department of Aerospace Engineering.

2. Provide each Aerospace Engineering student with a central source of information about the Department and its programs.

3. Provide students with a checklist of requirements for graduation so they can track their progression in the program.

This major field of study is designed primarily for those students who are interested in the analysis, design, and operation of aircraft and space vehicles.

The first two years of study are similar to those of other engineering majors and provide the student with a basic education for the engineering profession. Because engineering practice changes rapidly, emphasis is placed upon those physical and scientific principles and methods that form the soundest and broadest base for future work in aerospace engineering.

Depending upon the technical course selections made in the senior year, a student may emphasize aeronautics or astronautics, and specific technical areas within these fields, including aerodynamics, structural mechanics, flight mechanics, propulsion, and controls.

Students who intend to graduate in four years must successfully complete E Mch 210 (or E Mch 211 and 213), E Mch 212, CmpSc 201, and Math 220, 230, and 250 prior to the beginning of their third year (that is before taking aerospace courses); otherwise additional semesters may be required.

The University Faculty Senate approved a number of changes to the aerospace curriculum (summarized on pp. 4-5), effective March 2006. Please review these carefully, since they apply to all aerospace majors.

On behalf of the entire department, I welcome you to Aerospace Engineering! The faculty and staff will do everything possible to make your studies interesting and productive. I strongly urge you to meet with your academic advisor to discuss course scheduling, career opportunities, or other matters. Feel free to contact us about any matter you wish to discuss.

Best wishes for your success,

Robert G. Melton
Professor of Aerospace Engineering and
Director of Undergraduate Studies

Aerospace Engineering

Starting at University Park

NOTE: *All AERSP courses are offered only once a year in the semester shown on the schedule , except AERSP 305W (odd numbered semesters correspond to Fall, even numbers to Spring).*
Go to www.engr.psu.edu/AdvisingCenter/StudyAbroadAERO.aspx for a sample scheduling plan that incorporates a semester of study abroad.

1st Semester		
ENGL 15 or 30	Rhetoric & Comp. (or ECON)	3
•***CHEM 110***	***Chemical Principles***	***3***
•***MATH 140*** or ***140E***	***Calculus I***	***4***
•***PHYS 211***	***Mechanics***	***4***
First-Year Seminar		1
		15

2nd Semester		
ECON 2, 4 or 14 (GS) (or ENGL 15/30)		3
•***MATH 141*** or ***141E***	***Calculus II***	***4***
PHYS 212	Electricity & Magnetism	4
EDSGN 100	Intro. to Engr. Design	3
GA, GH or GS course		3
		17

3rd Semester		
MATH 230	Calc. & Vector Analysis	4
MATH 220	Matrices	2
E MCH 210 [A]	Statics & Str. of Materials	5
*CMPSC 201	Programming with C++	3
GA, GH or GS course		3
		17

4th Semester		
MATH 250	Ordinary & Differential Eqns.	3
M E 201	Thermal Science	3
CAS 100 A/B	Effective Speech	3
+E MCH 212	**Dynamics**	**3**
E MCH 315, 316	Mech. Response of Materials	3
		15

5th Semester		
+AERSP 301	**Aerospace Structures I**	**3**
+AERSP 309	**Astronautics**	**3**
+AERSP 311	**Aerodynamics I**	**3**
+AERSP 313	**Aerospace Analysis**	**3**
ENGL 202C	Technical Writing	3
Health & Physical Activity (GHA)		1.5
		16.5

6th Semester		
AERSP 304	Dynamics & Control	3
+AERSP 306	**Aeronautics**	**3**
AERSP 305W	Aerospace Tech. Lab	3
AERSP 312	Aerodynamics II	3
PHYS 214	Waves & Quantum	2
GA, GH or GS course		3
		17

7th Semester		
** AERSP 401A or 402A	Vehicle Sys. Design I	3
AERSP 410	Aerospace Propulsion	3
AERSP 413 or 450	Flight Vehicle Dynamics	3
Health & Physical Activity (GHA)		1.5
~AERSP Technical Elective		3
~AERSP Technical Elective		3
		16.5

8th Semester		
** AERSP 401B or 402B	Vehicle Sys. Design II	2
AERSP 440 or E E 212, or E E 210	Software Eng. or Electr. Meas. or Electr. Devices	3
~AERSP Technical Elective		3
Limited Elective (from dept. list)		3
GA, GH or GS course		3
GA, GH or GS course		3
		17

Total Credits - 131

• Courses listed in ***boldface italic type*** require a grade of C or better for entrance into this major
+ Courses listed in **boldface type** require a grade of C or better for graduation in this major.
[A] Students may substitute **E MCH 211** and **213** or **213D** for **E MCH 210**
* CMPSC 202 (Fortran) may be substituted
** Students may schedule either the spacecraft design sequence (401A & B) or the aircraft design sequence (402A & B). The appropriate control course (450 or 413) should be scheduled accordingly.
~ Up to 6 credits of Co-op, upon completion of the program, may be substituted for six of the nine required technical elective credits. For those students who complete the ROTC Program, 3 ROTC credits may be used to substitute for a technical elective and 3 ROTC credits may be used to substitute for the GHA requirement.

Aerospace Engineering

Starting at all Commonwealth Campuses

NOTE: *All AERSP courses are offered only once a year in the semester shown on the schedule except 305W (odd numbered semesters correspond to Fall, even numbers to Spring)***.**

Go to www.engr.psu.edu/AdvisingCenter/StudyAbroadAERO.aspx for a sample scheduling plan that incorporates a semester of study abroad.

1st Semester		
ENGL 15 or 30	Rhetoric & Composition	3
•CHEM 110	***Chemical Principles***	***3***
•MATH 140	***Calculus I***	***4***
EDSGN 100	Intro. to Engr. Design	3
First-Year Seminar		1
		14

2nd Semester		
ECON 2, 4 or 14 (GS)		3
•MATH 141	***Calculus II***	***4***
MATH 220	Matrices	2
•PHYS 211	***Mechanics***	**4**
GA, GH or GS course		3
		16

3rd Semester		
MATH 230	Calc. & Vector Analysis	4
* CMPSC 201	Programming with C++	3
PHYS 212	Electricity & Magnetism	3
CAS 100 A/B	Effective Speech	3
E MCH 211	Statics	3
		16

4th Semester		
MATH 250	Ordinary Diff. Eqns.	3
E MCH 213	Strength of Materials	3
** M E 201	Thermal Science	3
+E MCH 212	**Dynamics**	**3**
ENGL 202C	Technical Writing	3
GA, GH or GS course		3
		18

5th Semester		
+AERSP 301	**Aerospace Structures I**	**3**
+AERSP 309	**Astronautics**	**3**
+AERSP 311	**Aerodynamics I**	**3**
+AERSP 313	**Aerospace Analysis**	**3**
E MCH 315, 316	Mech. Response of Materials	3
Health & Physical Activity (GHA)		1.5
		16.5

6th Semester		
AERSP 304	Dynamics & Control	3
+AERSP 306	**Aeronautics**	**3**
AERSP 305W	Aerospace Tech. Lab	3
AERSP 312	Aerodynamics II	3
PHYS 214	Waves & Quantum	2
GA, GH or GS course		3
		17

7th Semester		
++AERSP 401A or 402A	Vehicle Sys. Design I	3
AERSP 410	Aerospace Propulsion	3
AERSP 413 or 450	Flight Vehicle Dynamics	3
~AERSP Technical Elective		3
~AERSP Technical Elective		3
Health & Physical Activity (GHA)		1.5
		16.5

8th Semester		
++AERSP 401B or 402B	Vehicle Sys. Design II	2
AERSP 440 or E E 212	Softw. Eng. or Electr.	3
or E E 210	Meas. or Electr. Devices	
~AERSP Technical Elective		3
Limited Elective (from dept. list)		3
GA, GH or GS course		3
GA, GH or GS course		3
		17

Total Credits - 132 ○

• Courses listed in ***boldface italic type*** require a grade of C or better for entrance into this major

+ Courses listed in **boldface type** require a grade of C or better for graduation in this major.

* CMPSC 121 may be substituted.

** M E 300 (Engineering Thermo. I) may be used as a substitute if ME 201 is not offered.

++ Students may schedule either the spacecraft design sequence (401A & B) or the aircraft design sequence (402A & B). The appropriate control course (450 or 413) should be scheduled accordingly.

~ Up to 6 credits of Co-op, upon completion of the program, may be substituted for six of the nine required technical elective credits. For those students who complete the ROTC Program, 3 ROTC credits may be used to substitute for a technical elective and 3 ROTC credits may be used to substitute for the GHA requirement.

○ 132 credits include 3 credits of E MCH 211 and 3 credits of E MCH 213 instead of E MCH 210 for 5 credits available at UP. Therefore the official total is 131 as shown for the UP start plan.

Summary of Curriculum Changes in Aerospace Engineering (effective 3/31/06)

Please note: these changes affect ALL students in the aerospace engineering major, regardless of when you were admitted to Penn State. We will examine each student's Degree Audit and make course substitutions, if necessary, to ensure that you do not have to take more credits than required when you were admitted to the degree program.

1. Requirements of E MCH 211 & 213 (6 cr.) can be also satisfied with E MCH 210 (5 cr.).
2. Requirement of PHYS 213 (2 cr.) has been dropped.
3. Requirement of MATH 251 (4 cr.) has been replaced with MATH 250 (3 cr.)
4. AERSP 311 & 312 have each been reduced from 4 cr. to 3 cr.
5. Requirement of ME 23 (3 cr.) has been replaced with ME 201 (3 cr.); students at locations where ME 201 is not offered should take ME 300.
6. Requirement of AERSP 302 (3 cr.) has been dropped. (A modified version of this course will become AERSP 470 – an Aerospace Technical Elective). Please note that if you have completed AERSP 302, you can use it as an Aerospace Technical Elective)
7. AERSP 401A and 402A have each been increased from 2 cr. to 3 cr.
8. A required Limited Elective (3 cr.) has been added (select from list on next page – students who completed PHYS 213 and MATH 251 prior to May 15, 2006 may use PHYS 213 plus 1 cr. from MATH 251 to count as the Limited Elective).
9. AERSP 301 and 311 are now C-required. (students who received a D in AERSP 301 prior to Fall 2006 may petition to replace that C requirement with a grade of C or better in E MCH 213, which was C-required until now; students who received a D in AERSP 311 prior to Fall 2006 may petition to replace that C requirement with a grade of C or better in at least 3 credits of MATH, PHYS, or engineering courses that are not C-required now).
10. AERSP 405W and 406W (total of 4 cr.) have been replaced with a single laboratory course: AERSP 305W (3 cr.).
11. Requirement of EE 212 (3 cr.) has been replaced with the choice of EE 212, or AERSP 440 (Aerospace Software Engineering – spring semesters), or EE 210 (4 cr.).

ROTC Students:
Upon completion of the ROTC program, ROTC students may use 3 cr. of ROTC for GHA (Health and Physical Activity) and 3 cr. of ROTC as follows: if they are using PHYS 213 and MATH 251 for the Limited Elective (as stated in #8 above), then these 3 cr. of ROTC may be used as the Technical Elective; otherwise, these 3 cr. of ROTC may be used as the Limited Elective. ROTC students may use AERSP 302 as an Aerospace Technical Elective.

Coop/Internship Students:

Coop/internship students may use 3 cr. of Coop/Internship courses for the Technical Elective, and 3 cr. of Coop/Internship as follows: if they are using PHYS 213 and MATH 251 for the Limited Elective (as stated in #8 above), then these 3 cr. of Coop/Internship may be used as an Aerospace Technical Elective; otherwise, these 3 cr. of Coop/Internship may be used as the Limited Elective. Coop/Internship students may use AERSP 302 as an Aerospace Technical Elective.

All Aerospace Majors:

If you completed PHYS 213 and MATH 251 prior to May 15, 2006, students may use 2 cr. of PHYS 213 and 1 cr. of MATH 251 together as the Limited Elective.

Aerospace Technical Electives (9 credits)

Students must select 9 credits as follows:

Aerospace Technical Electives -- 6 credits -- must be 400-level AERSP courses.

AERSP 302 also counts.

AERSP 204H/404H may be used for a maximum of 3 cr. of Aerospace Technical Electives.

AERSP 494 and 496 involve research or projects agreed upon by both the student and faculty *before* registering for these credits. A Department Registration Form must be completed at the beginning of each semester in which AERSP 494 or 496 credits are scheduled.

Technical Elective -- 3 credits -- must be 400-level courses chosen from the following programs: ACS, A E, AERSP, A B E, ASTRO, BIOE, CH E, C E, CMPSC, CSE, E E, E MCH, E SC, F SC, I E, IST, MATH, M E, METAL, METEO, NUC E, PHYS.

Also permitted in this category: ASTRO 291, 292, PHYS 237, Coop/Internship courses, EDSGN 497B (3 cr.) ProEngineer Tutorial, EDSGN 497G (2 cr.) AutoCAD tutorial.

Limited Elective (3 credits)

Students must select 3 credits from any of the following categories:

- Courses in the Aerospace Technical Elective list
- Courses needed to fulfill requirements for a minor
- Foreign-language courses (at any level)
- Courses in the Engineering Entrepreneurship Program
- Courses in the Engineering Leadership Development Program
- 3 credits of ROTC upon completion of the ROTC program
- 3 credits of Coop/Internship
- 2 cr. of Phys 213 and 1 cr. from MATH 251 (only if these courses were completed prior to May 15, 2006)

DEPARTMENT OF AEROSPACE ENGINEERING
UNDERGRADUATE PROGRAM OBJECTIVES

Revised 6/19/08

The Pennsylvania State University
Aerospace Engineering Undergraduate Program

Program Educational Objectives

This major emphasizes the analysis, design, and operation of aircraft and spacecraft. Students learn the theories and practices in the fundamental subjects of aeronautics, astronautics, aerodynamics and fluid dynamics, aerospace materials and structures, dynamics and automatic control, aircraft stability and control and/or orbital and attitude dynamics and control, air-breathing and rocket propulsion, aircraft systems design and /or spacecraft systems design. All of these place significant weight on the development and use of teamwork and communications skills for effective problem-solving.

Two to three years after obtaining a B.S. in aerospace engineering, graduates will be

1. employed in the customary settings such as government laboratories, large and small aerospace firms, and nontraditional positions that also require the use of systems-engineering approaches to problem-solving, or
2. pursuing graduate study in aerospace engineering and related fields.

Program Outcomes

The undergraduate program will provide students with the

a.) ability to apply knowledge of mathematics, science and engineering to all of the subjects in 1-8 above,
b.) ability to design and conduct experiments, analyze and interpret data in aerodynamics, propulsion, structures and control systems,
c.) ability to design a system, component or process to meet desired needs in aircraft systems or in spacecraft systems,
d.) ability to function on multi-disciplinary teams,
e.) ability to identify, formulate, and solve engineering problems,
f.) understanding of professional and ethical responsibility,
g.) ability to communicate effectively,
h.) broad education necessary to understand the impact of engineering solutions in a global and societal context,
i.) recognition of the need for, and an ability to engage in life-long learning,
j.) knowledge of contemporary issues,
k.) ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

l.) knowledge in all subjects in Category I or in Category II, and in some subjects in the other category: (Category I. aerodynamics, aerospace materials, structures, propulsion, flight mechanics, and stability and control), (Category II: orbital mechanics, space environment, attitude determination and control, telecommunications, space structures, and rocket propulsion).

Detailed Program Outcomes

Aerospace engineering B.S. graduates will be able to

1. Analyze the dynamics and control characteristics of aerospace vehicles, including the basic translational and rotational dynamics, and the basic theory and practice used to control these motions,

2. Analyze fluid dynamics, including the regimes of subsonic, transonic, and supersonic flows, inviscid and viscous flows, and laminar and turbulent flows,

3. Apply knowledge of the fundamentals of aeronautics, including aerodynamic characteristics of aircraft, propulsion systems, airplane performance, and elementary aircraft stability & control,

4. Apply knowledge of the fundamentals of astronautics, including orbital mechanics, attitude dynamics & control, rocket propulsion, and the space environment,

5. Predict performance, and conduct preliminary design, of gas turbine and rocket-based propulsion systems and their components,

6. Analyze the detailed dynamics, stability and control of either aircraft or spacecraft,

7. Analyze and design structural elements such as bars, beams, plates and thin-walled structures,

8. Make measurements to test hypotheses or to characterize the performance of physical systems (aerodynamic, structural, and control), and analyze and interpret the data in written reports,

9. Complete the successive stages of conceptual, preliminary, and detailed design of an aircraft or spacecraft mission and the associated vehicle(s),

10. Function effectively on teams to solve problems in complex aerospace systems that require knowledge of multiple disciplines,

Detailed Program Outcomes, cont'd

11. Apply an understanding of professional and ethical responsibility to realistic situations,

12. Make effective oral and written presentations in the format appropriate for the setting,

13. Explain how this profession affects society as a whole, and to demonstrate an appreciation of how technical issues guide societal actions,

14. Demonstrate an awareness of the need to stay abreast of technical developments throughout their working careers, and demonstrate that they are able to maintain and extend their learning, and

15. Make appropriate and effective use of computer software, hardware, and state-of-the-art laboratory instrumentation.

SPECIAL NOTES

RESPONSIBILITY FOR SCHEDULING

Please note that it is YOUR RESPONSIBILITY to schedule courses to MEET ALL REQUIREMENTS of the program. Your advisor, other faculty and certain staff members can assist you in making appropriate decisions where certain choices are available. The Department will track your progress, and notify you if you are in trouble academically. However, we cannot foresee your intentions in the scheduling of electives, particularly in Arts, Humanities and Social Science (AHS) courses. Therefore, please familiarize yourself with all requirements, and schedule accordingly.

PREREQUISITES

Our accrediting agency requires that we adhere to all rules, including prerequisite requirements. Prerequisite requirements will, therefore, be closely monitored, and students will not be permitted into courses without them. In particular, it is necessary for students to have completed all required Math courses, EMch 210 (or EMch 211 and 213), EMch 212, and CmpSc 201 prior to beginning the Junior year (5th semester), when the first Aerospace courses are scheduled. Also, it is necessary to have completed ME 201 (or ME 300 if ME 201 is not offered at your campus location) prior to scheduling the required Aerospace courses in the 6th semester.

ACCEPTANCE INTO THE MAJOR

Major declaration and notification of acceptance into Aerospace Engineering is conducted during the Spring semester of the sophomore year. It is absolutely necessary to have been accepted into the major before any required Aerospace course can be scheduled. Beginning in Spring 2005, the Aerospace major is under administrative enrollment control. Nominally, the top 100 requesting students (based upon cumulative GPA) will be allowed to enter this major; however, any student with a cumulative GPA of at least 3.0 will be permitted to enter the major.

POLICY ON PETITIONS

The Dean of Engineering will not consider any petitions for exceptions, waivers, course substitution, etc. during the semester in which you graduate. They must be submitted prior to the beginning of that term.

GPA REQUIREMENTS AND C-REQUIRED COURSES

Note that in order to graduate, you must have a cumulative grade point average (GPA) of 2.0 or better. Students must also receive a grade of C or higher in the following courses: EMch 212, Aersp 301, 306, 309, 311 and 313.

DIRECTOR OF UNDERGRADUATE STUDIES

Dr. Robert G. Melton is the Director of Undergraduate Studies. All petitions for deviations from the established rules, substitution of courses, and other special scheduling problems should be referred to him. His office is in 229 Hammond Building and his phone number is 865-1185.

EXPECTATIONS OF ACADEMIC INTEGRITY

Professional conduct, especially with regard to honesty and integrity, is a lifetime requirement for those pursuing an engineering career. The students in the Aerospace Engineering curriculum are expected to practice good ethics in every aspect of their educational studies. Students who violate this requirement will be subject to disciplinary action as determined by the University Faculty Senate Policy 49-20. (www.psu.edu/dept/ufs/policies)

University Faculty Senate Policy 49-20 – Academic Integrity

Definition and expectations: Academic integrity is the pursuit of scholarly activity in an open honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Academic integrity includes a commitment not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

To protect the rights and maintain the trust of honest students and support appropriate behavior, faculty and administrators should regularly communicate high standards of integrity and reinforce them by taking reasonable steps to anticipate and deter acts of dishonesty in all assignments (Senate Policy 44-40: Proctoring of Examinations). At the beginning of each course, it is the responsibility of the instructor to provide students with a statement clarifying the application of University and College academic integrity policies to that course.

Committee on Academic Integrity: Each College Dean (or Campus Executive Officer as determined by College policy) shall appoint a Committee on Academic Integrity made up of faculty, students, and academic administrators with faculty being the majority. This committee shall:

1. Promote expectations for academic integrity consistent with the definition in this policy.
2. Ensure fairness and consistency in processes and outcomes. To ensure University-wide consistency, College Committees will work with the Office of Judicial Affairs and the Office of the Provost of the University to develop procedures for handling and sanctioning dishonesty infractions.
3. Review and settle all contested cases in which academic sanctions are applied. If necessary, further disciplinary action will be taken by Judicial Affairs.
4. Record all cases of academic dishonesty within a college and report them to Judicial Affairs.

AEROSPACE COURSE OFFERINGS SCHEDULE
2009-2010 ACADEMIC YEAR

Fall Semester 2009				Spring Semester 2010		
AERSP Course	Cr.	Title		AERSP Course	Cr.	Title
001S	1	Aerospace Explorer		001S	1	Aerospace Explorer
097S	1	Hands-On Helicopters		097S	1	Hands-On Helicopters
204H	2	Flight Vehicle Design & Fabrication I		204H	2	Flight Vehicle Design & Fabrication I
301	3	Aerospace Structures		304	3	Dynamics and Control of Aerospace Systems
309	3	Astronautics		305W	3	Aerospace Technology Lab
311	3	Aerodynamics I		306	3	Aeronautics
313	3	Aerospace Analysis		308/308H	3	Mechanics of Fluids
401A	3	Spacecraft Design/Preliminary		312	3	Aerodynamics II
402A.001	3	Aircraft Design/Preliminary		401B	2	Spacecraft Design/Detailed
402A.002	3	Helicopter Design/Preliminary		402B.001	2	Aircraft Design/Detailed
404H	3	Flight Vehicle Design & Fabrication II		402B.002	2	Helicopter Design/Detailed
*407	3	Aerodynamics of V/STOL Aircraft		404H	3	Flight Vehicle Design & Fabrication II
410	3	Aerospace Propulsion		*423	3	Intro. to Numerical Methods in Fluid Dynamics
*412	3	Turbulent Flow		*430	3	Space Propulsion and Power Systems
413	3	Stability and Control of Aircraft		*440	3	Intro. to Software Engineering for Aerospace Engrs.
*420	3	Principles of Flight Testing		*470	3	Advanced Aerospace Structures
*424	3	Advanced Computer Programming		*473	3	Composites Processing
*425	3	Theory of Flight		*492	3	Space Astronomy and Intro. to Space Science
450	3	Space Dynamics		494	1-3	Aerospace Undergraduate Thesis
*460	3	Aerospace Control Systems		496	1-3	Aerospace Independent Studies
*490	3	Introduction to Plasmas		*497A	3	Advanced Orbital Mechanics
494	1-3	Aerospace Undergraduate Thesis		*497D	3	Special Topics in Aerodynamics
496	1-18	Aerospace Independent Studies		*497I	3	Space Environment Interactions
*497B	3	Experimental Methods and Projects		*497K	3	Aerospace Projects Lab
504	3	Aerodynamics of V/STOL Aircraft		505	3	Aero- and Hydroelasticity
508	3	Foundations of Fluid Mechanics		507	3	Theory and Design of Turbomachinery
514	3	Stability of Laminar Flows		509	3	Dynamics of Ideal Fluids
571	3	Foundations of Structural Dynamics and Vibration		525	3	Turbulence and Applications to CFD:RANS
590	1-3	Colloquium		550	3	Astrodynamics
596	1-9	Independent Studies		590	3	Colloquium
597A	3	Advanced Experimental Methods and Projects		596	1-18	Independent Studies
597I	3	Physics of Gases		597D	3	Special Topics in Aerodynamics
				597E	3	Estimation Theory
				597I	3	Spacecraft/Environment Interactions
				597J	3	Rotorcraft Stability and Control

Aersp 199, 299, 399, 499 (IL) (1-12 cr.) – Foreign Studies (effective Summer 2008)

*Technical Electives. Note: Not all of these are offered every year. Students must be admitted to the major to enroll in 300-level courses. Check with Aerospace Office late in the Spring Semester for Summer course offerings.

INSTRUCTIONS FOR COMPLETING YOUR CHECKSHEET OF COURSES

The CHECKSHEET OF COURSES REQUIRED FOR GRADUATION is an unofficial form that you can use to monitor progress toward graduation (The official audit is completed by the University Registrar using the automated Degree Audit system).

GENERAL REQUIREMENTS FOR GRADUATION

1. Completing satisfactorily all 131 credits required for graduation.

2. Earning at least a 2.0 cumulative grade point average.

3. Earning a C or better in the C-required courses.

The cumulative grade point average is taken from your Degree Audit. You must have an overall average of at least a 2.0 to graduate. As you complete the courses on the checksheet, fill in your grade in the space beside the course taken.

GENERAL GUIDELINES FOR COMPLETING THE CHECKSHEET

1. Do not give yourself credit for any courses not on your Degree Audit.

2. Do not include courses you have taken that are not listed on the checksheet. Substitutions usually require approval by petition to be used toward graduation.

3. Refer to Page 32 for the arts, humanities and social & behavioral science requirements.

4. If you have advanced standing credits or are in the 3-2 program, or have any problems, please see your advisor for assistance.

Student ID: _____

CHECKSHEET OF COURSES REQUIRED FOR GRADUATION

Name _____ E-Mail _____ Jr. Check: ___ Sr. Check: _____

Prescribed/Additional Courses

Course	Cr.	Grade
Aersp 301*	3	
Aersp 304	3	
Aersp 305W	3	
Aersp 306*	3	
Aersp 309*	3	
Aersp 311*	3	
Aersp 312	3	
Aersp 313*	3	
Aersp 401A & 401B *or*	3/2	___/___
Aersp 402A & 402B	3/2	___/___
Aersp 410	3	
Aersp 413 or 450	3	
Chem 110	3	
CmpSc 201	3	
EE 212 or Aersp 440 or EE 210	3	
EDSGN 100	3	
Econ 2, 4 or 14+	3	
Engl 202C	3	
EMch 210 (or EMch 211&213)	5	___/___
EMch 212*	3	
EMch 315	2	
EMch 316	1	
ME 201	3	
Math 140	4	
Math 141	4	
Math 220	2	
Math 230	4	
Math 250	3	
Phys 211	4	
Phys 212	4	
Phys 214	2	

[+]Also Gen Ed (SocSci)

General Education Supporting Courses

Communications/Phys.Ed./Health Ed. (10 credits)

	CR	
First Year Seminar	1	____
CAS 100A or 100B	3	____
Engl 15	3	____
Health & Physical Act.	3	____

(up to 3 cr. of ROTC may apply)

Arts, Humanities, Social Sciences Courses (15 credits)

(Selections must conform with College requirements)

			US or IL?
Gen Ed (Soc & Bhv. Sci.)	3	_____	___
Gen Ed (Human.)	3	_____	___
Gen Ed (Human.)	3	_____	___
Gen Ed (Arts)	3	_____	___
Gen Ed (Arts)	3	_____	___

Technical Electives (9 credits)

Aersp. _____	3	_____
Aersp. _____	3	_____
Aersp. _____	3	_____

(Up to 3 cr. Co-Op or a maximum of 3 cr. of AERSP 204H/404H may apply)

Limited Elective (3 credits) (see list on pg. 5)

_____	3	_____

(Up to 3 cr. ROTC or Co-Op may apply)

Other Courses Which May Be Used Toward Graduation

_____ _____

_____ _____

Other Courses Which May Not Be Used Toward Graduation

Meets Jr. Requirements: yes / no
Meets Sr. Requirements: yes / no
Meets College/Univ. Graduation Requirements: yes / no
Fall Spring Summer

JR. CUM. GPA	SR. CUM. GPA	CRED. JR. YR.	CRED. SR. YR. (131 req'd)
_____	_____	_____	_____

*Courses in bold type require a grade of C or better (see note on page 2 or 3 for further explanation).

Annotated Degree Audit

This official Degree Audit was generated from eLion, and represents the most up-to-date information about your progress toward completing your degree requirements in Aerospace Engineering.

The Audit is divided into 4 main sections: major requirements, minor requirements (if you are officially enrolled in a minor program), General Education requirements, and other university requirements. Each of these may contain several subrequirements.

In the left margin, a "YES" or a "+" indicates that a requirement or subrequirement has been met; a "NO" or a "-" indicates that it has not.

Actual Degree Audit is printed in this Courier Font.
Notations appear in this bold font.

```
---------------------------------------------------------------


PREPARED: 07/17/07 - 15:16                          9-xxxx-xxxx
DOE, JOHN Q.
AUDIT CODE:   B S  AERSP                      PROGRAM YEAR: 2006
                 PENN STATE DEGREE AUDIT REPORT
                      BACHELOR OF SCIENCE
                     AEROSPACE ENGINEERING
---------------------------------------------------------------
                Your Current Program Information

General Ed Year:  2005
Degree:           B S
Major/Option:     AERSP
Program Year:     2006
Minor:
Minor Year:
Honors in:
Honors Admit Sem:
Campus:           UP
Semester Class:   05
Cumulative GPA:   3.88
Deficiency Point:
Late Drop Credit: 16.0
Major Advisor:

    Your first registration date for campus UP FA07 - 04/10/07
    (Based on SU07 schedule +  74.00 total credits -- refer to
  Registration Instructions if schedule changed after 07/17/07)
---------------------------------------------------------------
        AT LEAST ONE REQUIREMENT HAS NOT BEEN SATISFIED
---------------------------------------------------------------
```

In your graduating semester, the above message will read:
ALL REQUIREMENTS HAVE BEEN MET OR ARE IN PROGRESS.

```
GRADES FOR SPRING SEMESTER 2007
      SP07 M E  023        3.0 A    SP07 E MCH012        3.0 A-
      SP07 MATH 250        3.0 A-   SP07 PHYS 214R       2.0 B+
      SP07 E MCH216        1.0 A    SP07 E MCH215        2.0 A
      SP07 CAS  100A       3.0 A-
-----------------------------------------------------------------
       CURRENT SCHEDULE
      FA07 AERSP301        3.0 SH   FA07 AERSP309        3.0 SH
      FA07 AERSP311        3.0 SH   FA07 AERSP313        3.0 SH
      FA07 ENGL 202C       3.0 SH   FA07 INART115        3.0 SH
-----------------------------------------------------------------
       ** GRADE POINT AVERAGE FOR THE MAJOR **
```

No major GPA shown since no AERSP courses have been taken yet.

```
-----------------------------------------------------------------
OK     MAJOR REQUIREMENT - SEMINAR
      FA05 AERSP097S       1.0 A
-----------------------------------------------------------------
NO     MAJOR REQUIREMENTS
    EARNED:  75.0 CREDITS
--> NEEDS:                          7 SUBREQMNTS

  +  1) PRESCRIBED COURSES (MAY APPLY TO GENERAL EDUCATION)
                           (C OR HIGHER REQUIRED)
      FA05 CHEM 012        3.0 S    FA05 MATH 140        4.0 A
      FA05 PHYS 211R       4.0 A    SP06 MATH 141        4.0 A

  +  2) PRESCRIBED COURSES (MAY APPLY TO GENERAL EDUCATION)
      FA05 ENGL 015        3.0 A-   SP06 PHYS 212R       4.0 A-
      SP07 PHYS 214R       2.0 B+   SP07 CAS  100A       3.0 A-
      FA07 ENGL 202C       3.0 SH

  +  3) ECONOMICS (MAY APPLY TO GENERAL EDUCATION)
      SP06 ECON 002        3.0 A

  +  4) ENGINEERING GRAPHICS
      FA05 ED&G 100        3.0 A

  +  5) INTERMEDIATE CALCULUS
      FA06 MATH 230        4.0 A-

  +  6) DIFFERENTIAL EQUATIONS
      SP07 MATH 250        3.0 A-

  +  7) COMPUTER SCIENCE
      FA06 CMPSC201C       3.0 A

  +  8) ADDITIONAL COURSES
      SP06 E MCH011        3.0 A    FA06 E MCH013        3.0 A
```

```
 -  9) TAKE ALL OF THE FOLLOWING
        **C OR HIGHER GRADE REQUIRED**
      SP07 E MCH012        3.0 A-   FA07 AERSP301        3.0 SH
      FA07 AERSP309        3.0 SH   FA07 AERSP311        3.0 SH
      FA07 AERSP313        3.0 SH
        COURSE LIST: AERSP306

  - 10) TAKE ALL OF THE FOLLOWING
      FA06 MATH 220        2.0 A-   SP07 M E  023        3.0 A
      SP07 E MCH216        1.0 A    SP07 E MCH215        2.0 A
        COURSE LIST: AERSP304 ,305W,312 ,410

  - 11) TAKE 8 CREDITS IN SPACECRAFT OR AIRCRAFT CONTROL
         NEEDS:    8.0 CREDITS
        COURSE LIST: AERSP401A OR 402A,401B OR 402B,413  OR
           AERSP450

  - 12) TAKE 3 CREDITS IN THE FOLLOWING
         NEEDS:    3.0 CREDITS
        COURSE LIST: AERSP440   E E  210 ,305

  - 13) TAKE 6 CRDTS IN AERSP TECHNICAL ELECTIVES-SEE DEPT LIST
         NEEDS:    6.0 CREDITS
```

Department lists appear on p. 5

```
  - 14) TAKE 3 CREDITS IN TECHNICAL ELECTIVES-SEE DEPT LIST
         NEEDS:    3.0 CREDITS

  - 15) TAKE 3 CREDITS IN LIMITED ELECTIVES-SEE DEPT LIST
         NEEDS:    3.0 CREDITS

----------------------------------------------------------------

NO     GENERAL EDUCATION REQUIREMENTS
    EARNED:  42.0 CREDITS
--> NEEDS:                            1 SUBREQMNT

  +  1) COMPOSITION (GWS)
      FA05 ENGL 015        3.0 A-

  +  2) WRITING (GWS)
      FA07 ENGL 202C       3.0 SH

  +  3) SPEECH COMMUNICATION (GWS)
      SP07 CAS  100A       3.0 A-
  +  4) QUANTIFICATION (GQ)
      FA05 MATH 140        3.0 A >S

  +  5) QUANTIFICATION (GQ)
      FA05 MATH 140        1.0 A >S SP06 MATH 141        2.0 A >S
```

```
  +  6) NATURAL SCIENCES (GN)
      FA05 CHEM 012        3.0 S    FA05 CHEM 014        1.0 TR
      FA05 PHYS 211R       4.0 A    SP06 PHYS 212R       1.0 A->S
```

Aerospace majors satisfy the GN and GQ requirements in Gen. Ed. via the required Physics and Math courses.

```
  +  7) ARTS (GA)
      SP06 LARCH060        3.0 A    FA07 INART115        3.0 SH


  +  8) HUMANITIES (GH)
      FA06 AM ST100        3.0 A    FA06 HIST 002        3.0 A

  +  9) SOCIAL AND BEHAVIORAL SCIENCES (GS)
      SP06 ECON 002        3.0 A

  + 10) SOCIAL AND BEHAVIORAL SCIENCES (GS)
      FA05 PSY  002        3.0 A

  - 11) TAKE 3 CREDITS IN HEALTH AND PHYSICAL ACTIVITY (GHA)
```

ROTC students must use 3 cr. of ROTC courses to meet the GHA requirement. – fill out a *Degree Audit Adjustment Form* in the Aerospace Department office to have those ROTC credits counted.

```
----------------------------------------------------------------
       OTHER COURSES
```

This section (Other Courses) may contain courses that you can substitute to meet certain requirements. Examples are:

1. **Up to 6 credits of foreign language courses at level-3 or higher can be petitioned for use as Humanities courses in Gen. Ed. (Ex: German 201, 301 could be used, but not Italian 002 – the numbering varies among departments).**
2. **Frequently, transfer credits (TR) from other universities will appear in this section; you must petition to have them counted toward your degree requirements.**
3. **Some (but not all) 400-level courses can be used to satisfy the Technical Elective requirement (major requirement #14 in the Degree Audit). Generally 496, 497 and 497x courses will require a formal petition.**
4. **Engineering Co-op courses will appear in this section. The Degree Audit system will not automatically count them as Technical Electives. Fill out a *Degree Audit Adjustment Form* in the Aerospace Department office to correct this.**

```
----------------------------------------------------------------
OK     HIGH SCHOOL FOREIGN/SECOND LANGUAGE ADMISSION REQUIREMENT
       NOTE: ADDITIONAL LANGUAGE PROFICIENCY REQ'D BY SOME MAJORS
----------------------------------------------------------------
OK     FIRST-YEAR SEMINAR
      FA05 AERSP097S       1.0 A
----------------------------------------------------------------
```

```
NO     WRITING ACROSS THE CURRICULUM
         TAKE 3 CREDITS IN 'W' SUFFIX COURSES FROM YOUR COLLEGE
```

Aerospace majors satisfy the W requirement by taking AERSP 305W.

```
-----------------------------------------------------------------
OK     UNITED STATES CULTURES AND INTERNATIONAL CULTURES (US/IL)
    EARNED:   6.0 CREDITS

  +  1) UNITED STATES CULTURES (US)
       FA06 AM ST100        3.0 A

  +  2) INTERNATIONAL CULTURES (IL)
       FA06 HIST 002        3.0 A
```

This requirement has changed to US/IL. Students admitted to degree status

- **prior to Summer 2005 satisfy the requirement with <u>one</u> 3-credit DF, GI, US, or IL course.**
- **after Spring 2005 must take a 3-credit US course <u>and</u> a 3-credit IL course.**

In either case, these courses can also be selected from the lists of courses that satisfy the GA, GH or GS requirements.

```
-----------------------------------------------------------------
IP     GENERAL GRADUATION REQUIREMENTS - SENATE POLICY 83-80
  +  1) AT LEAST 36 OF THE LAST 60 CREDITS MUST BE
         EARNED AT PENN STATE
         (  70.0 CREDITS TAKEN)
  +  2) AT LEAST 60 CREDITS MUST BE EARNED IN LAST FIVE YEARS
         (  74.0 CREDITS TAKEN)
-----------------------------------------------------------------
OK     MINIMUM 2.00 CUMULATIVE GRADE POINT AVERAGE REQUIRED FOR
       GRADUATION - SENATE POLICY 82-40
-----------------------------------------------------------------
NO     MINIMUM 131.0 CREDITS REQUIRED FOR GRADUATION
    EARNED:  74.0 CREDITS
IN-PROGRESS  18.0 CREDITS
--> NEEDS:   39.0 CREDITS
-----------------------------------------------------------------
```

These final 2 requirements are absolute: you <u>must</u> have at least 131 credits and a cumulative GPA of at least 2.0 to graduate.

```
LEGEND

NO  Requirement not completed
OK  Requirement completed
IP  Requirement in-progress, OK when satisfactorily completed
OR  One requirement/subrequirement of group needs to be completed
 -  Subrequirement not completed
 +  Subrequirement completed or in-progress
 *  Subrequirement not required, but courses apply
RG  Registered course
SH  Scheduled course
TR  Transfer course
IL  Independent Learning course, in-progress
```

```
PA  Portfolio assessment course
LD  Late dropped course
>R  Repeatable course, counts more than once
>Z  Duplicate course, counts once
>S  Credits split between two or more requirements
>Y  Credit limit for repeat course exceeded
---------------------------------------------------------------
This report is an unofficial working copy of a student's
progress toward an academic degree.  Graduation certification of
degree requirements is subject to the approval of the student's
college dean.  Questions about the report should be directed to
the student's academic adviser or college dean.
---------------------------------------------------------------
********************* END OF ANALYSIS *********************
```

COURSE	PREREQUISITE	PREREQUISITE OR CONCURRENT
Engl 15	Engl 004 or Satisfactory Placement Test	
Engl 202C	Engl 15 or 30, 4th Semester Standing	
Chem 110	Satisfactory Placement Test	
Math 140	Algebra & Trigonometry	
Math 141	Math 140	
Math 220	Math 110 or 140	
Math 230	Math 141	
Math 250	Math 141	
Phys 211		Math 140
Phys 212	Math 140 and Phys 211	Math 141
Phys 214	Math 141, Phys 211 and 212	
CmpSc 201	Math 140	Math 141
EDSGN 100		
EMch 212	EMch 211 or 210, Math 141	
EMch 210		Math 141
EMch 315	EMch 213, 210H or 210	
EMch 316		EMch 315
E E 212	Phys 212	
M E 201	Chem 110	
Aersp 204H	Consent of instructor	
Aersp 301	EMch 210 or 213	Aersp 313
Aersp 304	Aersp 313, EMch 212	
Aersp 305W		Aersp 301, 311, Engl 202C
Aersp 306	Aersp 311, 313	
Aersp 308	EMch 212 or 212H, Math 251	
Aersp 309	EMch 212, Math 250, CmpSc 201 or 202	

COURSE	PREREQUISITE	PREREQUISITE OR CONCURRENT
Aersp 311	EMch 212, Math 250, CmpSc 201 or 202	
Aersp 312	Aersp 311, 313, M E 201	
Aersp 313	CmpSc 201 or 202, Math 220, 230, 250	
Aersp 401A	Aersp 309	Aersp 450
Aersp 401B	Aersp 301, 401A	
Aersp 402A	Aersp 306	Aersp 413
Aersp 402B	Aersp 301, 402A	
Aersp 404H	Consent of instructor; Aersp 204H	
Aersp 407	Aersp 312	
Aersp 410	Aersp 312	
Aersp 412	One Course in Fluid Mech	
Aersp 413	Aersp 304, 306	
Aersp 420	Aersp 306	
Aersp 423	Aersp 312 or ME 320, CmpSc 201 or 202, Math 250 or 251	
Aersp 424	MATH 220, CMPSC 201 or 202	
Aersp 425	Aersp 306	
Aersp 430	Aersp 410 or ME 432	
Aersp 440	CmpSc 201 or 202	
Aersp 450	Aersp 304, 309	
Aersp 460	Aersp 304	
Aersp 470	Aersp 301	Aersp 304 , EMch 315
Aersp 473	EMch 471*	
Aersp 490	EE 330 or Phys 467*	
Aersp 492	Phys 400 or EE 330*	
Aersp 494	7th Semester Standing	

*Consult advisor on possible substitutions

AEROSPACE ENGINEERING COOPERATIVE EDUCATION AND INTERNSHIP PROGRAMS

Cooperative Education: Aerospace Engineering participates in the cooperative education program in the College of Engineering. This program provides one FULL YEAR of work experience divided into THREE SEGMENTS: a fall semester, a spring semester and a summer session. These work periods alternate with periods in school. A student should enter the program at the end of the sophomore year and schedule courses that summer. The first work experience normally begins in the following Spring semester of the junior year. In the event that it is necessary to begin in the summer or fall, a special schedule can be devised. (See the Department Co-op Coordinator for help in this matter). Thereafter, work and school alternate until three work segments are completed. In this program, the student graduates in December of the first half of the fifth school year instead of May at the end of the fourth school year, thus completing the degree program in four-and-one-half years. For students admitted into the major and electing the cooperative education program, the curriculum plans for the last two-and-one-half years are shown on the following page. Note that the student is either in school or at work for three summer sessions beginning the summer after the end of the sophomore year. This schedule is necessary only if the student intends to graduate in 4 ½ years.

Students who elect to participate in the cooperative education program will interview with employers participating in this program late in their sophomore year. The interviewing process is like that for permanent employment; both employer and student must agree as to terms. Students selected will register for 1 to 3 credits of Engr 295A, Engr 395A, and Engr 495A, successively, for each of the three work sessions. Six of these credits can be used as follows: 3 credits for the Limited Elective, and 3 credits for a Technical Elective. At the end of each session, a report evaluating the experience will be submitted to the Department Co-op Coordinator. This report will serve as a basis for a grade in the respective course.

Students gain several benefits from this program. They get to work in a real world environment and get a sampling of what practicing aerospace engineers do on the job. This experience should serve to enlighten students more on what areas to pursue in future studies and what skills are most essential to develop. It also provides a means for earning some money prior to graduation while working in one's professional field. A Certificate is provided by the University upon completion of the entire formal Co-op Program. To apply, students must attend a Co-Op Preparation Workshop, held at the beginning of each semester.

Internships: An internship is an academic credit course for students any time after completion of their first semester at Penn State. Internship students typically work for one semester, but have the option of working multiple rotations at one company by rolling into a co-op or working at multiple companies for multiple internships.

For further information, or to apply, contact:

(Coord. to be announced for 09-10)
Aerospace Co-Op Coordinator
229 Hammond Building

Amy Custer
Undergraduate Program Staff Assistant
229 Hammond Building
865-6432
asm1@engr.psu.edu

Co-Op Office
205 Hammond
863-1032
coop@engr.psu.edu

AEROSPACE ENGINEERING CO-OP SCHEDULE

YEAR 3

SUMMER		FALL		SPRING
CAS 100 A/B	3	AERSP 301	3	WORK
EMCH 315-316	3	309	3	(ENGR 295A)
	6	311	3	
		313	3	
		AHS	3	
		Health & Phys. Act	1.5	
			16.5	

YEAR 4

SUMMER		FALL	SPRING	
ENGL 202C	3	WORK	AERSP 305W	3
E E 212	3	(ENGR 395A)	304	3
	6		306	3
			312	3
			AHS	3
			Health & Phys. Act.	1.5
				16.5

YEAR 5

SUMMER	FALL		SPRING
WORK	AERSP 401A	3	
(ENGR 495A)	402A	3	
	410	3	
	413/450	3	
	TECH ELECT	3	
	TECH ELECT	3	
		18	

NOTE: This schedule assumes 6 credits of co-op courses will be used toward Technical and Limited Elective requirements. If no co-op credits are substituted for technical electives, two additional 3-credit technical electives must be scheduled.

AEROSPACE ENGINEERING COURSE DESCRIPTIONS

001S. ***Aerospace Explorer*** (1) First-Year Seminar explores aerodynamics, structural mechanics, flight mechanics, rotorcraft systems, high performance computers, air/space propulsion and space systems. Offered both semesters.

097S. ***Hands-on Helicopters*** (1) The Hands-On Helicopters First Year Seminar will introduce first year students to the fascinating world of vertical flight during the summer semester. Students will visit a helicopter hangar, see a radio-controlled helicopter demonstration, and participate in several activities to learn about the basic properties of helicopters. Each meeting period (8 periods total) will include a 75-minute instruction period followed by a 90-minute lab session.

199. ***Foreign Studies*** (1-12) Courses offered in foreign countries by individual or group instruction.

204H. ***Flight Vehicle Design and Fabrication I*** (2) Integrated project management, design, fabrication, testing, and flight evaluation of an advanced composite flight vehicle. Intended for Schreyer Scholars (freshmen and sophomores).

299. ***Foreign Studies*** (1-12) Courses offered in foreign countries by individual or group instruction.

301. ***Aerospace Structures I*** (3) Aerospace structural design concepts, flight safety. Stiffness, strength, stability of thin-walled structures under combined loads. Energy methods, finite element analysis. Prerequisite: EMch 213 or EMch 210. Prerequisite or concurrent: Aersp 313.

304. ***Dynamics and Control of Aerospace Systems*** (3) Vibrations of single, multiple, and infinite degree-of-freedom systems; operational methods applied to aerospace vehicles; design of controllers. Prerequisites: Aersp 313, EMch 212.

305W. ***Aerospace Technology Lab*** (3) Experiments in measurement systems, aerodynamics, aerospace structures, dynamics and control, and propulsion, technical report writing and presentations. Prerequisite or concurrent: Aersp 301, Aersp 311, Engl 202C.

306. ***Aeronautics*** (3) Lift and drag characteristics of aircraft; propulsion systems; airplane performance; introduction to stability and control. Prerequisites: Aersp 311, 313.

308H. ***Mechanics of Fluids* (3) Kinetics and dynamics of fluids; perfect fluid theory using complex variables; introduction to viscous flow theory; fundamentals of compressible flow. Prerequisites: EMch 212 or 212H; Math 251.

309. ***Astronautics*** (3) Introduction to space and space flight; laws of particle mechanics; orbits and trajectories; space vehicles and propulsion. Prerequisites: EMch 212, Math 250, CmpSc 201 or 202.

311. ***Aerodynamics I*** (3) Fluid statics and kinematics; fluid dynamics of inviscid and viscous flows; Navier-Stokes equations; introduction to boundary layers. Prerequisites: EMch 212, Math 250, CmpSc 201 or 202.

312. ***Aerodynamics II*** (3) Fluid mechanics of viscous and compressible flows, laminar boundary layers, turbulent flows, isentropic flows, shock waves, supersonic lift and drag. Prerequisites: Aersp 311, 313, ME 201.

313. ***Aerospace Analysis*** (3) Mathematical methods applied to aerospace engineering: Fourier series, ordinary and partial differential equations, complex variables, numerical methods. Prerequisites: Math 220, 230, 250, CmpSc 201 or 202.

399. ***Foreign Studies*** (1-12) Courses offered in foreign countries by individuals or group instruction.

The following 400-level courses may be taken by upperclassmen and graduate students:

401A. ***Spacecraft Design - Preliminary*** (3) Conceptual and preliminary design of a spacecraft, its constituent subsystems, and related systems, to satisfy a given set of specifications. Prerequisite: Aersp 309. Prerequisite or concurrent: Aersp 450.

401B. ***Spacecraft Design - Detailed*** (2) Detailed design of the constituent subsystems and related support systems for a spacecraft. Prerequisites: Aersp 401A, 301.

402A. ***Aircraft Design - Preliminary*** (3) Conceptual and preliminary design of an aircraft, its constituent subsystems, and related systems, to satisfy a given set of specifications. Prerequisite: Aersp 306. Prerequisite or concurrent: Aersp 413. *Note: section 001 focuses on fixed wing aircraft design and section 002 focuses on rotary wing aircraft design.*

402B. ***Aircraft Design - Detailed*** (2) Detailed design of the constituent subsystems and related support systems for an aircraft. Prerequisites: Aersp 402A, 301. *Note: section 001 focuses on fixed wing aircraft design and section 002 focuses on rotary wing aircraft design.*

*404H. ***Flight Vehicle Design and Fabrication II*** (3) Integrated project management, design, fabrication, aerodynamic and structural testing, and flight evaluation of an advanced composite flight vehicle. Prerequisite: Aersp 204H.

*407. ***Aerodynamics of V/STOL Aircraft*** (3) Rotary wing aircraft; VTOL and STOL performance; propeller-wing combinations; jet flap; high lift devices. Prerequisite: Aersp 312.

410. ***Aerospace Propulsion*** (3) Analysis and performance characteristics of reciprocating engine, turbo-jet, turbo-prop, turbo-fan, ram-jets, and chemical rockets. Aerothermodynamics of inlets, combustors, and turbomachinery. Prerequisite: Aersp 312.

*412. ***Turbulent Flow*** (3) Homogeneous turbulence, spectral transfer of energy, viscous dissipation; turbulent shear flow: mixing-length theory, eddy viscosity, scaling laws, energy budget. Prerequisite: one course in fluid mechanics.

413. ***Stability and Control of Aircraft*** (3) Static and dynamic stability and control of aircraft; open and closed loop systems. Prerequisites: Aersp 304, 306.

*420. ***Principles of Flight Testing*** (3) In-flight and analytical studies of airplane performance, stability, and control; reduction of data; instrumentation; flight test techniques. Prerequisite: Aersp 306.

*423. ***Introduction to Numerical Methods in Fluid Dynamics*** (3) Finite difference methods applied to solving viscid/inviscid fluid dynamics problems, error control, numerical stability. Prerequisites: Aersp 312 or ME 320; CmpSc 201 or 202; Math 250 or 251.

*424. ***Advanced Computer Programming*** (3) Engineering and scientific programming topics: object oriented programming, parallel programming, and various modern languages (e.g. C++, Java, and Ada). Prerequisites: CmpSc 201 or 202 or equivalent, Math 220.

*425. ***Theory of Flight*** (3) Advanced wing and airfoil theory, conformal mapping, slender body theory. Prerequisite: Aersp 306.

*430. ***Space Propulsion and Power Systems*** (3) Analysis and performance of chemical and nuclear rockets, electric propulsion systems. Introduction to solar, chemical, thermoelectric, and nuclear power sources. Prerequisite: Aersp 410 or ME 432.

*440. ***Introduction To Software Engineering For Aerospace Engineers*** (3) Software engineering for safety- and mission-critical systems, including requirements, management, processes, designs, programming, validation/verification, and other aspects of software development. Prerequisite: CmpSc 201 or CmpSc 202.

450. ***Orbit and Attitude Control of Spacecraft*** (3) Principles of mechanics and vector analysis applied to basic concepts of satellite motion and control, rocket ballistics, and gyroscopic instruments. Prerequisites: Aersp 304, 309.

*460. ***Aerospace Control Systems*** (3) Design and analysis of feedback control systems for aerospace applications; stability, root locus, time- and frequency-domain, state-space methods. Prerequisite: Aersp 304.

*470. ***Advanced Aerospace Structures*** (3) Design and analysis of aerospace structures. Plates and sandwich panels; composite materials; structural dynamics; aeroelasticity; damage tolerance. Prerequisite: Aersp 301. Prerequisite or concurrent: Aersp 304, EMch 315.

*473. (EMch 473) ***Composites Processing*** (3) An introduction to the principles of mechanics governing manufacturing, computer-aided design, and testing of composite materials and structures. Prerequisite: EMch 471.

*490. (EE 490, NucE 490) ***Introduction to Plasmas*** (3) Plasma oscillations; collisional phenomena; transport properties; orbit theory; typical electric discharge phenomena. Prerequisite: EE 330 or Phys 467.

*492. (EE 472) ***Space Astronomy and Introduction to Space Science*** (3) The physical nature of the objects in the solar system; the earth's atmosphere, ionosphere, radiation belts, magnetosphere, and orbital mechanics. Prerequisites: Phys 400 or EE 330.

*494. ***Aerospace Undergraduate Thesis*** (1-3 per semester, maximum of 6) Individual problem investigations reported in written thesis and seminar lectures. Cooperative research with faculty guidance on topics of current interest. Prerequisite: seventh-semester standing.

*496. ***Independent Studies*** (1-18)

*497. ***Special Topics*** (1-9)

*497B. ***Experimental Methods and Projects*** (3) Established experimental methods used in a variety of research areas in aerospace engineering. The lectures and practice laboratory sessions are accompanied by an engineering project that utilizes a more advanced measurement technique in experiments.

*497I. ***Spacecraft Environment Interactions*** (3) This course will examine various aspects of spacecraft aerodynamics and interactions with the space environment. The course will include some aspects of spacecraft design and the latest computational methods for calculating spacecraft aerodynamic forces and moments and thruster plume contamination.

*497K. ***Aerospace Engineering Projects*** (3) Team projects involving design, build, test of major components of aeronautical or astronautical vehicles (including software development or simulation). The course emphasizes methods for planning and monitoring the projects.

499. ***Foreign Studies*** (1-12) Courses offered in foreign countries by individuals or group instruction.

*Technical Elective Courses. Some of these may not be offered every year.
**Service courses not applicable to Aerospace Engineering program.

500-LEVEL COURSES

Any senior with at least a 3.50 grade-point average may be admitted to 500-level courses with the consent of the instructor. This approval is only for coordination purposes. In fact, undergraduate students are encouraged to take one or two graduate courses in their undergraduate curriculum. This is particularly beneficial for students considering the pursuit of a graduate program following their BS degree. Seniors with a 3.00-3.49 average may be admitted to graduate courses with the consent of the instructor, the student's academic adviser, and the associate dean of the Office of Graduate Student Programs.

504. ***Aerodynamics of V/STOL Aircraft*** (3) Jet wings, high lift devices, propellers and ducted propellers, circulation and boundary layer control, unsteady airfoil theory. Prerequisite: Aersp 407. (offered in Fall semester)

505. ***Aero- and Hydroelasticity*** (3) Interaction of elastic systems having several degrees of freedom with fluid flows in various configurations. (offered Spring semester in even years)

506. ***Rotorcraft Dynamics*** (3) Modeling and analysis techniques for dynamic response, vibration, aeroelastic stability, and aeromechanical stability of rotary-wing vehicles. Prerequisites: Aersp 504, EMCH 571. (offered Spring semester in odd years)

507. ***Theory and Design of Turbomachinery*** (3) Theory and principles of machinery design: compressors, turbines, pumps, and rotating propulsors; opportunity to work out design examples. (offered Spring semester in even years)

508. ***Foundations of Fluid Mechanics*** (3) Mathematical review, fluid properties, kinematics, conservation laws, constitutive relations, similarity principles, the boundary layer, inviscid flow, vorticity dynamics, wave motion. (offered Fall semester only)

509. ***Dynamics of Ideal Fluids*** (3) Irrotational flow theory, two-dimensional and axisymmetric flows, airfoil theory, complex variables, unsteady phenomena; flow with vorticity, finite wing theory. Prerequisite: Aersp 508. (offered Spring semester in even years)

510. ***Compressible Flow*** (3) Classification and solution of compressible flow problems, high-speed gas dynamics, unsteady motion, transonic and hypersonic flows, atmospheric reentry.

511. ***Aerodynamically Induced Noise*** (3) Review of fluid mechanics. General theory of aerodynamic sound. Noise radiation from jets, boundary layers, rotors, and fans. Structural response. (offered Fall semester in even years)

512. ***Viscous Flow*** (3) Stress-deformation relations; Newtonian fluids, Navier-Stokes equations; exact, asymptotic laminar solutions; instability, transition; similitude and turbulent boundary layer.

514. ***Stability of Laminar Flows*** (3) The stability of laminar motions in various geometries as influenced by boundary conditions and body forces of various kinds. (offered Fall semester in odd years)

518. ***Dynamics and Control of Aerospace Vehicles*** (3) Dynamical problems of aircraft and missiles including launch, trajectory, optimization, orbiting, reentry, stability and control, and automatic control. Prerequisite: Aersp 413 or 450. (offered Spring semester in odd years)

524. (ME 524) ***Turbulence and Applications to CFD: DNS and LES*** (3) First of two courses: Scalings, decompositions, turbulence equations; scale representations, Direct and Large-Eddy Simulation' modeling; pseudo-spectral methods; 3 computer projects. Prerequisite: a graduate-level course in fluid mechanics. (offered Spring semester in odd years)

525. (ME 525) ***Turbulence and Applications to CFD: RANS*** (3) Second in two courses: Scalings, decomposition, turbulence equations; Reynolds Averaged Navier Stokes (RANS) modeling; phenomenological models; 3 computer projects. (offered Spring semester in even years)

526. (ME 526) ***Computational Methods for Shear Layers*** (3) Study of numerical solution methods for steady and unsteady laminar or turbulent boundary-layer equations in two and three dimensions. Prerequisite: Aersp 423 or ME 523.

527. (ME 527) ***Computational Methods in Transonic Flow*** (3) Numerical solution of partial differential equations of mixed type, with emphasis on transonic flows and separating boundary layers. Prerequisite: Aersp 423 or ME 523.

528. (ME 528) ***Computational Methods for Recirculating Flows*** (3) Numerical solution techniques for laminar/turbulent flow with large recirculation zones. Both primitive variable and stream function-vorticity equations used. Prerequisites: ME 523.

529. (ME 529) ***Advanced Analysis and Computation of Turbomachinery Flows*** (3) Review of numerical methods; three-dimensional inviscid flow computation; two-and three-dimensional viscous flow effects and computation; recent advances. Prerequisites: Aersp 423, Aersp 507 or ME 422.

530. ***Aerothermochemistry of Advanced Propulsion Systems*** (3) Physics and chemistry needed to analyze advanced rocket propulsion systems including reacting high temperature radiating gas and plasma flows. Prerequisites: Aersp 312 or ME 420. (offered Spring semester in odd years)

540. (EE 571, NUC E 540) ***Theory of Plasma Waves*** (3) Solutions of the Boltzmann equation; waves in bounded and unbounded plasmas; radiation and scattering from plasmas. Prerequisite: EE 471.

550. ***Astrodynamics*** (3) Applications of classical celestial mechanics to space flight planning. Determination and construction of orbital parameters by approximation methods. Perturbation techniques. Prerequisite: Aersp 450 or EMch 410 or Phys 419. (offered Spring semester in even years)

560. ***Finite Element Method in Fluid Mechanics and Heat Transfer*** (3) Introduction to finite element method, interpolations, numerical integration, iso-parametric elements, variational principles, method of variations, method of weighted residuals, potential flow solutions, transient heat conduction, parabolic diffusion problems, full potential equations solutions for transonic flows. (offered Spring semester in odd years)

571. (ME 571, EMch 571) ***Foundations of Structural Dynamics and Vibration*** (3) Modeling approaches and analysis methods of structural dynamics and vibration. Prerequisites: Aersp 304, EMch 470, ME 450, or ME 470. (offered in Fall semester)

590. ***Colloquium*** *(Seminar)* (3) Presentations of ongoing research in aerospace engineering by faculty and senior doctoral students. (offered every semester)

596. ***Independent Studies*** (1-18)

597. ***Special Studies*** (1-18)

*597A. ***Rotorcraft Aeromechanics*** (3) This experimental course is divided approximately 50-50 between helicopter stability and control and helicopter acoustics. This course is computer intensive and requires you to write the following three programs: prediction of rotor performance in hover using vortex theory; prediction of rotor performance in hover and forward flight; and prediction of stability and motion.

*597A. ***Advanced Experimental Methods and Projects*** (3) Established experimental methods used in a variety of research areas in aerospace engineering. The lectures and practice laboratory sessions are accompanied by an engineering project that utilizes a more advanced measurement technique in experiments. (offered Fall semester in odd years)

*597C. ***Statistical Orbit Determination*** (3) This course is an introduction to the mathematics and practices in statistical orbit determination. The major topics are: classical orbit determination techniques, probability and statistics, least squares solution, weighted least squares, statistical interpretation of the least squares problem, Cholesky decomposition, Guass-Markoff theorem, sequential estimation algorithms, extended sequential estimation algorithms, square root filters, state noise compensation algorithm, smoothing algorithms, minimum variance, maximum likelihood, Bayesian estimation. Other topics as time permits. Prerequisites: Aersp 450 or consent of the instructor. (offered Spring semester in odd years)

*597C. ***Interplanetary Astrodynamics*** Prerequisite: Aersp 450

*597D. ***Special Topics in Aerodynamics*** (3) Formal courses given on a topical or special interest subject which may be offered infrequently; several different topics may be taught in one year or term. (offered Spring semester in even years)

*597E. ***Linear and Nonlinear Estimation*** (3) This course will cover estimation and data fusion for linear and nonlinear systems: (a) introduction to Gaussian random variable; (b) Gauss-Markov estimation and the Best Linear Unbiased Estimator; (c) minimum mean square error estimators; (d) Kalman filter; (e) Extended Kalman filter and the Sigma Point Kalman Filter; (f) effects of non-Gauss noise and non-Gaussian initial state estimates; (g) histogram and particle filters. Examples will be taken from aerospace and robotics applications, including (among others): fusion of GPS and inertial measurements; robot localization; target tracking; and simultaneous localization and mapping. (offered Spring semester in even years)

*597F. ***Behavior of Advanced Composite Structures*** (3) Analysis techniques for composite beams, plates, and shells, energy and finite element formulations, elastic tailoring concepts, buckling of composite structures. Prerequisites: Aersp 302, EMch 471 or equivalent introductory course in composite materials. (offered Fall semester in even years)

*597F. ***Smart Structures*** (3) Over the last 10-15 years there has been tremendous interest in the use of smart materials as elements of "adaptive" structures. This class of materials includes, among others, piezoelectric materials, shape memory alloys, and electro- and magneto-rheological fluids. The course covers the fundamental behavior of these materials, their constitutive modeling, develops models for the introduction of smart materials as elements of adaptive structures (in particular for structural vibration reduction, damping augmentation, and shape control or morphing applications), addresses issues such as sizing and optimal placement of actuators and sensors in structures, and examines different control strategies and the resulting system behavior. Several smart materials application case studies are also presented. (offered Fall semester in odd years)

*597G. ***Introduction to Global Positioning*** (3) This course will provide an understanding of the GPS architecture, signals, measurement, performance and estimation of position, velocity and time. It will cover augmentation such as differential GPS and carrier phase measurements. (offered Spring semester in odd years)

*597I. (ME 535) ***Physics of Gases*** (3) An introduction to kinetic theory, statistical mechanics, quantum mechanics, atomic and molecular structure, chemical thermodynamics, and chemical kinetics. (offered in Fall semester)

*597I. ***Spacecraft Environment Interactions*** (3) This course will examine various aspects of spacecraft aerodynamics and interactions with the space environment. The course will include some aspects of spacecraft design and the latest computational methods for calculating spacecraft aerodynamic forces and moments and thruster plume contamination. (offered in Spring semester)

*597J. ***Rotorcraft Stability and Control*** (3) Development of a set of general equations of motion of a rotorcraft in maneuvering flight. The generalized trim problem. Linearized equations of motion and stability derivatives. Stability and control analysis of rotorcraft. Rotorcraft flight simulation. Handling qualities analysis and automatic flight control design for rotorcraft. (offered Spring semester in even years)

*597K. ***Small Scale Turbomachinery*** (3) Aero-thermo-mechanical design of small gas turbine systems for unmanned-aerial vehicle (UAV) systems. (offered Fall semester in even years)

599. ***Foreign Studies*** (1-2 per semester/maximum of 4) Courses offered in foreign countries by individual or group instruction.

* For **497** and **597** courses, suffix letters can change from year to year. When determining what courses to take, be sure to check the course title.

GENERAL EDUCATION REQUIREMENTS IN ARTS, HUMANITIES, AND SOCIAL AND BEHAVIORAL SCIENCES

General Education requirements include a broad range of courses totaling 52 credits. Many of these, such as those in Quantification and Natural Sciences, are included in the basic requirements for the program.

An important area of general education that engineers must specifically address, however is that of the 18 credits of Arts, Humanities and Social & Behavioral Sciences (AHS) courses.

Specifically, the requirements are:

1. Take 6 credits (usually two 3-credit courses) in each of three areas:

   Arts (GA)
   Humanities (GH)
   Social & Behavioral Sciences (GS)

2. Take one of the 3-credit courses in the above list in the area of Intercultural and International courses (GI or DF).

   Beginning summer 2005, the Intercultural and International Competence (GI) requirement has been replaced by a requirement in United States Cultures (US) and International Cultures (IL). Courses approved to fulfill this requirement will be designated as US, IL, or both US and IL. The degree audit will monitor the completion of the requirement for each student based on his/her program year.

   Students admitted to baccalaureate or associate degree status before summer 2005 must complete a 3-credit course that is US, IL, or both US and IL. However, students who have fulfilled their Intercultural and International Competence requirement with a course designated as DF or GI are exempt from this requirement. Any semester- or year-long Penn State-approved study abroad program can be used to satisfy the requirement.

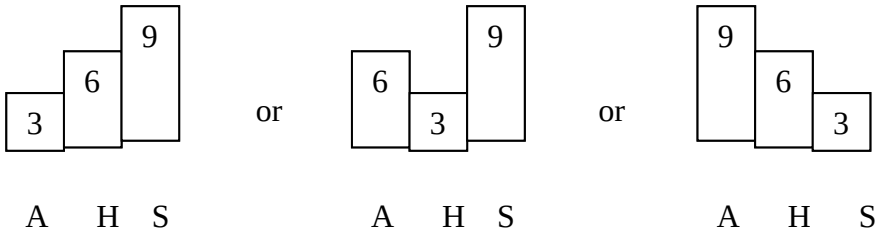
   Students admitted to baccalaureate degree status after spring 2005 must complete 3 credits in US and 3 credits in IL. If a student takes a 3-credit course that is both US and IL, to complete the requirement, he/she must take another 3-credit course that is US, IL, or both US and IL. Associate degree candidates must complete a 3-credit course that is US, IL, or both US and IL. Education abroad courses and other credit-bearing experiences such as internships that meet this requirement will be designated as US, IL, or both US and IL.

Any courses listed in the Penn State Baccalaureate Degree Programs Bulletin (http://www.psu.edu/bulletins/bluebook/gened/) as GA, GH, or GS, respectively, can be used to satisfy this requirement. Note that Econ 002, 004 or 014 is a specific requirement of our program, and also serves as one of the Social Science (GS) courses.

Substitutions

What is most important about General Education is that the "spirit" of the requirements be met. This means that when possible, the College of Engineering allows for flexibility in how the requirements are actually met. This may entail taking a slightly different pattern than what is indicated on the previous page, or it may mean permission to have one or more courses count for General Education that are not officially listed as General Education courses. The following are suggestions for how you might make course substitutions which still meet the spirit of the General Education requirements in the COE (other colleges may approach this differently):

- 9/6/3 sequence in the Arts (GA), Humanities (GH), and Social Sciences (GS) – instead of taking 6 credits in each of these 3 areas, you are allowed to take 9 credits in one and balance this out by taking only 3 credits in one of the others. The remaining area would then stay at 6 required credits. Examples of this are;



- Language substitution – a language course at the 12th credit level or higher can be substituted for 3 credits of Arts, Humanities, or Social Science requirements. *Note: if this substitution is made, it cannot be the ONLY course in a category (i.e. it cannot be substituted for the 3 credit category in the 3-6-9 pattern shown on the previous page).* Beginning language courses at Penn State are 4 credits each, so the 12th credit level would be a level III course (Span 003, Italian 003, French 003, etc.). If a student intends to take a language course elsewhere, (s)he should consult with an adviser first, as the 12th credit level may be defined differently at other institutions.

- Experiential IL – students with life experiences which meet the spirit of the Intercultural/International Competence requirement may petition to have this count as their IL requirement. Examples of such experiences include study abroad, some internships, and working in the Peace Corps.

- AP credits – some credits gained through Advanced Placement tests in high school may be used to meet degree requirements. Students must request to have these credits accepted by contacting the Admissions Office.

- Other course substitutions – any course not designated as General Education, but which truly meets the spirit of the GA, GH, GS, or IL requirements, whether taken at Penn State or elsewhere, may be petitioned to count in the appropriate area. *Key to the success of this type of petition is detailed documentation on what the course covered and, if possible, a written statement by the instructor of the course on the appropriateness of these courses as a GA, GH, GS, or IL.* Students should seek the assistance of their academic advisers for the preparations and submission of this type of petition.

Petitions for Course Substitutions

Students may request course substitutions by completing a College of Engineering petition form. This can be used for any course, including those needed to meet requirements for General Education and for the major.

If the petition concerns a Department requirement, the Director of Undergraduate Studies (Dr. Melton) will decide whether to approve it. Petitions concerning General Education, or other College or University requirements, must first receive a recommendation from the Department, and then are forwarded to the Assistant Dean for Student Services for a decision.

Procedure

1. Plan to submit the petition and receive a decision *before* taking the substitute course. (In some cases, this is not possible, but be aware that not all petitions are approved.)
2. Obtain a petition form from Amy Custer in the Dept. of Aerospace Engineering office (229 Hammond) or print form at: http://www.engr.psu.edu/Forms/GeneralPetition.pdf
3. Complete and sign the form.
4. Obtain your advisor's signature, and return the form to Amy.
5. For retroactive adds, drops, or withdrawals, you must include a letter petitioning the University Faculty Senate. Address the letter to the Senate Committee on Undergraduate Education, and include copies of relevant documents to support your petition. (You may wish to confer with Dr. Melton about what documentation is needed.) See instructions at: http://www.engr.psu.edu/Forms/SenatePetitionsInstructions.pdf

Petitions will be placed in your official file after completion by all required authorities. Check with Amy about 10 days after submitting the petition to determine the decision.

How to Write the Petition

1. State your request clearly and completely. The evaluators will base their decisions upon your written statements (and the information on your transcript).
2. *Do not ask to waive or set aside a requirement or course*; instead, cast the request in terms of what you wish to *substitute* for a particular course or to meet a particular requirement.
3. Give an adequate justification: explain the circumstances that have led to your request. *Do not simply state "To allow me to graduate on time."*

Note: the Dean of Engineering will not consider petitions in the semester that you graduate; petitions must be submitted prior to the beginning of your final semester.

All Petitions are treated in strict confidence.

LIST OF AEROSPACE FACULTY AND STAFF

Faculty Members

Name	Title	Office	Phone	E-Mail
Dr. Sven Bilén	Associate Professor (EE, Design)	213N Hammond	863-1526	sgb100@psu.edu
Dr. Kenneth S. Brentner	Professor	233D Hammond	865-6433	ksbrentner@psu.edu
Dr. Cengiz Camci	Professor	223 Hammond	865-9871	c-camci@psu.edu
Dr. Steven C. Conlon	Assistant Professor (ARL)	Water Tunnel	863-3027	scc135@only.arl.psu.edu
Dr. Farhan S. Gandhi	Professor	231C Hammond	865-1164	fgandhi@psu.edu
Dr. J. William Holl	Professor Emeritus	224 Hammond	865-8453	jwh8@psu.edu
Dr. Joseph Horn	Associate Professor	233H Hammond	865-6434	joehorn@psu.edu
Dr. Robert F. Kunz	Associate Professor (ARL)	Water Tunnel	865-2144	rfk102@only.arl.psu.edu
Dr. Jacob W. Langelaan	Assistant Professor	233G Hammond	863-6817	jwl16@psu.edu
Dr. George A. Lesieutre	Professor & Department Head	222A Hammond	863-0103	g-lesieutre@psu.edu
Dr. Deborah Levin	Professor	233E Hammond	865-6435	dalevin@psu.edu
Dr. Lyle N. Long	Distinguished Professor	229C Hammond	865-1172	lnl@psu.edu
Dr. Mark D. Maughmer	Professor	233F Hammond	863-4485	mdm@psu.edu
Dr. Barnes W. McCormick	Boeing Professor Emeritus	231B Hammond	863-0602	bwmaer@engr.psu.edu
Dr. Dennis K. McLaughlin	Professor	230A Hammond	865-2560	dkm2@psu.edu
Dr. Robert G. Melton	Professor & Director of Undergraduate Studies	229B Hammond	865-1185	rgmelton@psu.edu
Dr. Michael M. Micci	Professor & Director of Graduate Studies	230C Hammond	863-0043	micci@psu.edu
Dr. Philip J. Morris	Boeing/A.D. Welliver Professor	233C Hammond	863-0157	pjm@psu.edu
Dr. Edward C. Smith	Professor	231D Hammond	863-0966	ecs5@psu.edu
Dr. Hubert C. Smith	Associate Professor Emeritus	230B Hammond	865-7783	hcsaer@engr.psu.edu
Dr. David B. Spencer	Associate Professor & Director of Graduate Programs, College of Engineering	229A Hammond	865-4537	dbs9@psu.edu

Staff Members

Name	Title	Room	Phone	E-mail
Ms. Jane Auhl	Software Systems Assistant	222 Hammond	863-6349	jea5@psu.edu
Ms. Michelle Barnyak	Department Staff Assistant	225 Hammond	865-2569	mlf1@psu.edu
Ms. Rhonda Beard	Part-Time VLRCOE Staff Assistant	233 Hammond	867-2845	rjb23@engr.psu.edu
Ms. Tammy Besecker	Part-Time Administrative Assistant	222 Hammond	863-6357	tdb1@psu.edu
Ms. Debbie Boyle	Accounting Clerk	227B Hammond	865-1043	dub6@psu.edu
Ms. Arabella Confer	Bookkeeper	227B Hammond	863-1077	avc11@psu.edu
Ms. Sheila Corl	Administrative Assistant	227A Hammond	865-6997	sxi1@psu.edu
Ms. Amy Custer	Undergraduate Program Staff Assistant	229 Hammond	865-6432	asm1@engr.psu.edu
Ms. Deborah Mayes	Department Head Staff Assistant	225A Hammond	863-0065	dvm3@engr.psu.edu
Ms. Debbie Mottin	Staff Assistant for IHPCA & Rotorcraft Centers	233B Hammond	865-1966	daj122@psu.edu
Ms. Nancy Nagle	Graduate Program Staff Assistant	229 Hammond	865-6431	ncn2@psu.edu

Laboratory Staff

Mr. Richard R. Auhl	Laboratory Director	226 Hammond	(814)777-5381	rraaer@engr.psu.edu
Mr. Mark S. Catalano	IT Manager	226 Hammond	(814)777-5703	mac9@psu.edu
Mr. Kirk Heller	Systems Administrator	48 Hammond	865-5703	akh123@psu.edu

SPECIAL INTEREST AREAS OF AEROSPACE FACULTY

SVEN G. BILÉN, Associate Professor of Engineering Design, Electrical Engineering, and Aerospace Engineering; Ph.D., Electrical Engineering, University of Michigan.

Systems engineering and design, spacecraft systems, spacecraft environments and plasma interactions, electrodynamic tethers, electric propulsion, plasma devices and diagnostics, and nanosatellite systems.

KENNETH S. BRENTNER, Professor of Aerospace Engineering; Ph.D., Engineering/Acoustics, University of Cambridge, (United Kingdom)

Rotorcraft and aircraft aeroacoustics, computational aeroacoustics, fluid mechanics, computational fluid dynamics, and high-performance computing

CENGIZ CAMCI, Professor of Aerospace Engineering; Ph.D., Convective Heat Transfer and Fluid Dynamics, Von Karman Institute and Katholieke Universiteit Leuven (Belgium).

Aerothermodynamics of turbomachinery, convective heat transfer, short duration wind tunnel techniques, finite element techniques for flow and heat transfer calculations, laser Doppler anemometry, and liquid crystal imaging for heat transfer studies.

STEPHEN C. CONLON, Assistant Professor of Aerospace Engineering; Ph.D., Acoustics, The Pennsylvania State University

Structural acoustics and vibration, random vibrations, noise control, passive damping, structural health monitoring, experimental vibroacoustics, sonic fatigue.

FARHAN S. GANDHI, Professor of Aerospace Engineering; Ph.D., Aerospace Engineering, University of Maryland.

Structural dynamics and control, use of smart materials in morphing and biologically inspired structures, helicopter dynamics and aeroelasticity including vibration reduction, stability augmentation and advanced configurations such as unmanned and micro aerial vehicles.

JOSEPH F. HORN, Associate Professor of Aerospace Engineering; Ph.D., Aerospace Engineering, Georgia Institute of Technology.

Aircraft flight dynamics and control, automatic flight control system design for rotorcraft, simulation and modeling of rotorcraft, rotorcraft handling qualities, nonlinear adaptive control, control system design for envelope limit avoidance.

ROBERT KUNZ, Adjunct Associate Professor; Ph.D., Aerospace Engineering, The Pennsylvania State University.

Computational fluid dynamics, multiphase flows, turbomachinery.

JACK W. LANGELAAN, Assistant Professor of Aerospace Engineering; Ph.D., Aeronautics and Astronautics, Stanford University.

Sensor fusion, estimation, trajectory planning and control of autonomous systems. Work involves algorithm development, simulation and hardware experiments.

GEORGE A. LESIEUTRE, Professor and Head of Department, Associate Director, Center for Acoustics and Vibration; Ph.D., Aerospace Engineering, University of California at Los Angeles.

Structural dynamics and vibration damping; composite structures, material damping modeling and characterization, piezoceramic actuation, structural control.

DEBORAH A. LEVIN, Professor of Aerospace Engineering; Ph.D, Chemistry, California Institute of Technology.

Modeling of chemically reacting flows, hypersonic and supersonic flows, thermochemical nonequilibrium effects, direct simulation Monte Carlo computer modeling, modeling of optical radiation and comparison with space flight experiments.

LYLE N. LONG, Distinguished Professor of Aerospace Engineering, Director of the Institute for High Performance Computing Applications and Co-Director of the Penn State Vertical Lift Research Center of Excellence; D.Sc., Aerospace Engineering, George Washington University.

Computational fluid dynamics and hypersonics; massively parallel processing, aeroacoustics, and molecular dynamics.

MARK D. MAUGHMER, Professor of Aerospace Engineering; Ph.D., Aeronautical and Astronautical Engineering, University of Illinois at Urbana-Champaign.

Analytical, computational and experimental aerodynamics; aircraft design, performance, stability and control, airfoil design and analysis, low-Reynolds number aerodynamics.

BARNES W. McCORMICK, Boeing Professor Emeritus of Aerospace Engineering; Ph.D. Aeronautical Engineering, The Pennsylvania State University.

Low-speed aerodynamics in general, flight mechanics, aerodynamics of vertical flight, propeller design (including marine propellers), hydrodynamics, aerodynamic noise, and the behavior of vortex systems.

DENNIS K. McLAUGHLIN, Professor of Aerospace Engineering; Ph.D., Aeronautics and Astronautics, Massachusetts Institute of Technology.

Experimental fluid dynamics and aeroacoustics; the aerodynamics and aeroacoustics of supersonic jets and remote sensing of aircraft wake vortices and the development of a flying boat recreational vehicle.

ROBERT G. MELTON, Professor of Aerospace Engineering, and Director of Undergraduate Studies; Ph.D., Engineering Physics, University of Virginia.

Astrodynamics, spacecraft dynamics and control; trajectory optimization, perturbation analysis of low-thrust orbital motion, orbit determination, dynamics and control of multi-body spacecraft.

MICHAEL M. MICCI, Professor of Aerospace Engineering and Director of Graduate Studies; Ph.D., Aerospace Engineering, Princeton University.

Rocket propulsion; experimental and analytical work on oscillatory burning of solid and liquid propellants, rocket motor instabilities, advanced propulsion concepts particularly the heating of propellant gases to high temperature by the absorption of microwave radiation, optical diagnostics of nozzle flows expanding into a vacuum.

PHILIP J. MORRIS, Boeing/A.D. Welliver Professor of Aerospace Engineering and Associate Director of the Institute for High Performance Computing Applications; Ph.D., Aeronautical Engineering, University of Southampton (England).

Computational aeroacoustics; computational and analytical fluid dynamics; thermoacoustics; hydrodynamic stability; turbulence modeling in high-speed flows; aerodynamics and acoustics of jets; protective technology.

EDWARD C. SMITH, Professor of Aerospace Engineering and Co-Director of the Penn State Vertical Lift Research Center of Excellence; Ph.D., Aerospace Engineering, University of Maryland.

Composite structures, rotorcraft dynamics; aeroelastic and aeromechanical tailoring of composite rotor blades, composite beam modeling, elastomeric materials.

HUBERT C. SMITH, Associate Professor Emeritus of Aerospace Engineering; Ph.D., Aerospace Engineering, University of Virginia.

Aircraft design, performance and operations; low-speed aerodynamics and air transportation.

DAVID B. SPENCER, Associate Professor of Aerospace Engineering and Director of Graduate Programs for the College of Engineering; Ph.D., Aerospace Engineering Science, University of Colorado (Boulder).

Astrodynamics, high accuracy orbit determination, space debris research, spacecraft trajectory optimization, spacecraft dynamics and control, space systems engineering.

INFORMATION RESOURCES

Advising

Each student is assigned an official advisor to help with scheduling, career planning, or other academic matters. Your advisor's name appears on your eLion account. Do not hesitate to see your advisor if you have any questions or problems. If your advisor is not available, ask one of the Department staff assistants to identify another advisor who can meet with you.

Dr. Robert G. Melton serves as principal advisor, and may also be consulted, particularly on complex scheduling problems.

Coursework Consultation

Professors, graduate teaching assistants, and undergraduate teaching interns hold scheduled office hours for student help. If you cannot meet during the scheduled office hours, arrange for a special appointment by emailing or calling the professor or TA.

Engineering Library

The Engineering Library on the third floor of Hammond Building houses thousands of volumes of engineering texts, periodicals, and literature. Most material can be checked out of the library upon presentation of the student's identification card. Several photocopy machines are available, as well as areas to study.

Tutoring/Help Sessions

One-on-one tutoring for 300-level aerospace engineering courses will be provided by Sigma Gamma Tau members during scheduled times. Group help sessions will be arranged if warranted by substantial interest on a particular subject. Scheduled tutoring hours will be announced in class and via an email to aerospace students.

STUDENT SOCIETIES AND ORGANIZATIONS

American Helicopter Society

The American Helicopter Society (AHS) student chapter is the Department's newest organization, having received its charter from the parent organization in July 1980. Our AHS student chapter is now one of the largest and most active chapters in the country. If you are interested in joining the AHS, please watch the AHS bulletin board for meeting notices or contact Dr. Edward C. Smith, the faculty advisor to the Student Branch. You can reach Dr. Smith at 863-0966.

American Institute of Aeronautics and Astronautics (AIAA)

The AIAA is the largest American technical society devoted to science and engineering in the fields of space, technology, rocket systems, aerodynamics and marine systems. Students are encouraged to join the Penn State Student Branch of the AIAA. Membership applications and information on the benefits of belonging to this organization may be obtained from the AIAA faculty advisor. Meetings and social events (including a picnic) are held regularly during the academic year. Members can also attend the annual student conference for the Mid-Atlantic Region each April. Listen for announcements in class and watch the AIAA bulletin board outside of 227 Hammond for notices. Dr. Robert G. Melton, 229B Hammond, is the faculty advisor to the AIAA Student Branch.

Sigma Gamma Tau

Sigma Gamma Tau is the National Honor Society in Aerospace Engineering. The Sigma Gamma Tau Society is established to recognize and honor those individuals in the field of aeronautics who have through scholarship, integrity, and outstanding achievement been a credit to their profession. The Society seeks to foster a high standard of ethics and professional practices and to create a spirit of loyalty and fellowship, particularly among students of Aerospace Engineering.

The students eligible for membership include undergraduate aerospace engineering students in the upper one-quarter of their junior class and the upper one-third of their senior class. Each spring semester, qualified students will be notified of their eligibility to join Sigma Gamma Tau.

The faculty advisor of Sigma Gamma Tau is Dr. Jack Langelaan (863-6817).

Penn State Soaring Club

The Penn State Soaring Club is an organization open to all members of the University community. It exists to promote the sport of soaring and to give its members an opportunity to fly inexpensively.

The club currently operates three club sailplanes: two L-13 Blaniks and a Schempp-Hirth Standard Cirrus. The soaring season begins in the Spring when the weather begins to clear and generally runs through the end of December, or until snow covers the ground. The club operates on a three-semester per year basis (Spring, Summer and Fall). The club flies out of Ridge Soaring Gliderport, located in Julian, PA (about 20 minutes from campus).

Professor Mark Maughmer (863-4485) can be contacted for more information. Also look for postings on the aerospace bulletin board announcing meeting times and information.

NOTE: Fun and valuable trips to aerospace industries, local chapters of international organizations, aircraft design and construction classes, and local flying clubs are conducted only through the Department of Aerospace Engineering. We strongly encourage you to participate in the societies and organizations listed above. As future aerospace engineers, you can greatly benefit by getting involved in these programs to learn more about your profession of choice, and to experience these activities with your aerospace peers.

SCHOLARSHIP INFORMATION

The University, the College of Engineering, and the Department of Aerospace Engineering annually award a number of scholarships. Students are automatically considered for all of these. Some scholarships require a demonstrated financial need; to qualify, a student *must* complete the FAFSA form each year (www.fafsa.ed.gov).

For departmental scholarships, a committee reviews the relevant information on all eligible students and notifies the awardees by mid-July. Some scholarship endowments permit multiple awards each year, but the number and amount will vary depending upon available funds. The department scholarships are:

Aero Pioneers Class of 1944 Scholarship
Lou Borges Scholarship in Aerospace Engineering
John Pierre Hemler Scholarship
Mary Ilgen Memorial Scholarship
Richard W. Leonhard Scholarship
John and Brenda Myers Endowed Scholarship in Aerospace Engineering
James R. Norris Memorial Scholarship
David J. Peery Scholarship
Carl A. Shollenberger Memorial Scholarship
Donald G. and Jayne L. Steva Scholarship

Additional scholarships are offered by the American Institute of Aeronautics and Astronautics (AIAA), Boeing, and the Vertical Flight Foundation, with application information mentioned below.

AIAA Scholarship Program

The national AIAA Scholarship Program provides $2000 yearly awards to deserving undergraduate students. Selection criteria include scholarship (3.3 cum. avg.), ability to apply concepts of science and engineering, personal assessment of career goals (a 500-1000 word essay), and recommendations. Applications must be received at AIAA Headquarters in Reston, VA by January 31 each year.

Further information and application forms may be obtained from the advisor to the Penn State Student Branch of the AIAA (Dr Robert G. Melton, 229B Hammond), or by writing directly to the Scholarship Program, Student Activities Committee, American Institute of Aeronautics and Astronautics, 1801 Alexander Bell Drive, Suite 500, Reston, VA 20191. You may also visit their website at www.aiaa.org for more information and an online application form.

Boeing Scholarship

Boeing has traditionally provided scholarships to students in several engineering disciplines, including aerospace. Currently they are offering a total of 17 scholarships to students with an interest in the aerospace industry. **Students must actually apply for these by completing a letter of application, and including their resume and one letter of recommendation.** Details are posted on the College of Engineering website at http://www.engr.psu.edu/Scholarships/default.aspx. The deadline to apply for this scholarship is usually mid-September each year.

Vertical Flight Foundation

The Vertical Flight Foundation (VFF) is the philanthropic arm of the American Helicopter Society (AHS). The Foundation is governed by a Board of Trustees and functions as an independent charitable trust for the support of scientific and educational activities related to Vertical Takeoff and Landing (VTOL) flight. Each year, the VFF awards merit-based scholarships, each at a value up to $2,000, to undergraduate or graduate students interested in pursuing engineering careers in the helicopter or vertical flight industry. Applications for the VFF scholarship may be obtained from the AHS faculty advisor, Dr. Edward C. Smith, 231-D Hammond Building, or visit http://www.vtol.org/VFFSchoForm.pdf for an application.

OPPORTUNITIES FOR HANDS-ON EXPERIENCE

Flight Vehicle Design and Fabrication Course

The Flight Vehicle Design and Fabrication course is a multi-year course administered through the Department of Aerospace Engineering and the Schreyer Honors College. The coursework is vertically integrated to give freshmen and sophomores experience in aerospace engineering principles by working with juniors and seniors on design projects. Students are allowed to explore implications that their design will have in manufacturing the final product by spending lab hours building their part. The current design project is a high-performance sailplane to be constructed of composite materials. The class is broken into several design and manufacturing teams that work interactively to achieve goals that are set at the beginning of each semester, toward the completion of the full-scale sailplane. This course is open to aerospace engineering students in the Honors program, as well as other highly-motivated aerospace engineering students. Consent of the instructor is required for scheduling AERSP 204H or AERSP 404H. Not all of the credits earned in these courses can be applied toward requirements of the program. None of the credits earned in the freshman year will apply, and approximately two thirds of the rest can be used. The first such credits normally substitute for the design courses (AERSP 401 or 402) or the lab course (AERSP 305W). If sufficient credits are earned to cover these areas, additional ones can be used as a technical elective. For more detailed information, contact the course leader, Dr. Mark Maughmer (863-4485).

SPIRIT Project

The SPIRIT project provides an opportunity for students from a wide range of educational backgrounds to gain hands-on experience in the design and fabrication of a research sounding rocket. It is a part of the NASA Student Launch Program that enhances classroom experience while emphasizing creativity, collaborative learning and time management skills. Penn State students traveled to Norway in early summer 2006 to launch SPIRIT III from the Andøya Rocket Range.

Members of SPIRIT III constructed a rocket that deployed experiments to measure particle densities in the mesosphere. The data collected from the flight will enhance the understanding in mesospheric research. Penn State undergraduate students collaborated with Penn State faculty members, NASA engineers and students from Norway (the University of Oslo, the Technical University of Narvik, and the University of Bergen) to accomplish their goals. Ranging from freshmen to seniors, these students had diverse interests and backgrounds, including many from Aerospace Engineering -- several of these in leadership roles.

NanoSat Project

Part of the University Nanosat Program, sponsored by the Air Force, NASA, and AIAA, NittanySat is being designed by students in Aerospace, Electrical, and Mechanical Engineering. Twelve universities are participating, with students managing the projects and meeting various program goals, with design and safety reviews. Following the final review in December 2009, one or more satellites will be selected for flight qualification and launch. Students can participate via independent study. For more detailed information, contact Dr. Robert Melton or Dr. David Spencer.

Rocket Project

A sounding rocket project for undergraduate students was initiated by the department in fall of 2001, to offer the students a challenging hands-on space-related learning experience. The projects have been successfully integrated into the two senior laboratory courses. The students built a rocket and incorporated a commercially available flight computer as the payload. The flight computer contained a microcontroller as well as various sensors to measure acceleration and pressure. Students compared flight performance with predictions after the first flight in October 2001. Following a catastrophic launch failure in April 2002, a new rocket, the Phoenix, was successfully flown in April 2003. The 2003 flight was a milestone, having incorporated our program into a new incentive at NASA's Wallops Island Center. The Phoenix rocket is a pioneer in an outreach program NASA Wallops is initiating. Students can participate via independent study. For more detailed information, contact the course leader, Dr. David B. Spencer.

3-2 Program

The Department offers a dual degree program in cooperation with a number of Liberal Arts schools throughout Pennsylvania. Students enrolled in these programs, known as "3-2 Programs," complete the first three years at the Liberal Arts institution, and two years in Aerospace Engineering at Penn State. Upon successful completion of the program, students receive a B.A. or B.S. in Liberal Arts (usually with a Physics major) from the first institution, and a B.S. in Aerospace Engineering from Penn State. Students accepted into Aerospace Engineering in this program will normally be given 76 transfer credits. The curriculum from the Liberal Arts institution should include courses in statics, dynamics, strength of materials, thermodynamics and computer science. If any of these courses are not included, it would be wise to schedule them over the summer prior to enrolling in Aerospace courses. All general education requirements are normally included in the 76 transfer credits. However, the program should be reviewed with an advisor to make certain that all requirements are covered. One advanced physics or mathematics course could be transferred and applied toward the technical elective requirements.

Undergraduate Teaching Internship (UGTI)

The Undergraduate Teaching Internship Program is an opportunity for selected Aerospace Engineering students to act as Undergraduate Teaching Interns in their senior year. They will attend seminars on teaching methods and ideology, teach two course lectures, run review sessions, and hold office hours. Announcements are made and applications are accepted during the Spring semester of the Junior year. Selection of the interns will be made in mid-June, at which time a faculty mentor and course will be assigned to the student. Selected applicants are assigned to a 300-level class to assist the professor and graduating teaching assistant. This program is an opportunity to experience the teaching side of a class, strengthen subject knowledge, and earn a stipend. An announcement will be made during the Spring semester with more information.

AERSP 494 - Aerospace Undergraduate Thesis

An undergraduate thesis is a research project arranged between a student and a professor on a subject of mutual interest, which results in a formal thesis. Up to three credits of AERSP 494 may be scheduled, and applied toward technical electives, during the senior year, for research and writing of the thesis. Typically one credit is taken in the Fall Semester and two in the Spring.

AERSP 496 - Independent Studies

Independent Studies involves the accomplishment of a project agreed upon by both the student and the advising faculty member. Information regarding ongoing projects may be mentioned in class or distributed via email. In addition to scheduling the course, a Department Registration Form must be completed at the beginning of each semester in which AERSP 496 credits are scheduled. Registration forms may be obtained in the main office (229 Hammond).

COMPUTER FACILITIES

Penn State Information Technology Service (ITS) computer facilities available to undergraduate aerospace engineers include IBM-compatible and MacIntosh personal computers, and Unix workstations. In addition, the computer center has a 61-node IBM SP2 computer for numerically intensive applications. Personal computers and workstations are available at public computer labs across campus. Real-time information on computer availability in these labs can be found at www.its.psu.edu.

Personal computer and Unix workstations are located in the third floor Hammond Building computer lab. The Aerospace Engineering Computer Lab, Room 131 Hammond Building, contains IBM-compatible personal computers. Most of the computer labs are outfitted with laser printers. Accounts for using these computers are often established in various aerospace engineering classes. If you need accounts set up for the PCs or the card reader for 131 Hammond Building, please see Mark Catalano, IT Manager, 226 Hammond Building, or Kirk Heller, Systems Administrator, 48 Hammond Building.

The Aerospace Engineering student computer lab consists of numerous computers and peripherals, and a Fast Ethernet 10/100 MB network. Should you have difficulty getting a system to meet your needs, please see Mark Catalano or Kirk Heller.

ITS regularly holds classes and/or information sessions on operating systems and popular systems and application software available on the various computer platforms. Information regarding ITS and its services may be obtained from any of the campus student computer labs. Lab operators are often stationed in the computer labs to help with student computer needs. They are an excellent source of information if you have trouble with computer hardware/software or just need information.

What follows is a summary list of popular software used by aerospace engineering students, grouped by type of application. This is not an all-inclusive list; rather, it is intended to give the student a feel for some of the software packages available for use. Detailed information on the software available can be obtained from ITS, computer labs, the lab operators, or at: http://www.its.psu.edu

Computer hardware and software can be purchased at the Microcomputer Order Center (12 Willard Building) or the Penn State Bookstore.

Programming

Programming software is used to create your own programs, often to solve engineering problems. Various programming languages, including FORTRAN, C, C++, MATLAB, BASIC, and PASCAL are available on most computer platforms. Ready-to-use software libraries, such as IMSL, LINPACK, and EISPACK, are available for student use through the network, providing specific code addressing typical engineering problems.

Wordprocessing

Wordprocessing software can be used to write, edit, and print reports, letters, documents, resumes, and theses. Popular wordprocessing software includes Microsoft Word. These software packages are available on the personal computers.

Spreadsheets

Spreadsheet software is essentially used for dealing with numerical data. Data can be manipulated, analyzed, and plotted in a spreadsheet program. EXCEL is a spreadsheet available on the personal computers.

Computer Aided Design (CAD)

Computer aided design (CAD) software allows the user to build and manipulate a structure on a computer. Some advanced CAD packages and Pro Engineer on the PC's perform static and dynamic structural analysis and optimization. A simpler, more straightforward CAD package is AutoCAD2007, available on the personal computers in 131 Hammond Building.

Presentations

Presentation software can be used to create, edit, and print slide shows, handouts, and speeches. Powerpoint is the presentation software package available on the personal computers.

Math Software

Several math software packages are available to solve simple and complex mathematical problems. Mathematica and MathCAD are two symbolic math software processors. Matlab is also available on some computers.

RESEARCH FACILITIES AND EQUIPMENT IN THE AEROSPACE ENGINEERING DEPARTMENT

Major research facilities include a low-turbulence subsonic wind tunnel with a 3.25 x 5 foot test section, speed range to 150 mph, and a floor mounted six-component strain gauge balance; an additional low-turbulence wind tunnel with a 2-foot by 3-foot test section; a laminar flow water channel (2.5 x 1.5 foot test section); an axial flow turbine facility with heavily instrumented blading to measure unsteady pressures, heat transfer, and shear stresses; a heat transfer facility to simulate turbine flow; a linear turbine cascade for heat transfer research; a real time color image processing system for the post processing of liquid crystal images in convective heat transfer research; various probe calibration jets; several laser Doppler anemometers including a subminiature semiconductor model; an ATC/510G flight simulator; aeroacoustic research facilities—a jet noise facility, an anechoic chamber, and a reverberant room; a vacuum tank facility for low-density flow (pressure range to 10^{-4} Torr, pumping approximately 5000 cfm at 5 x 10^{-3} Torr) and associated instrumentation; an unsteady propellant combustion facility and a variable power microwave generator; and a compressed air flow facility (300-psi reservoir); a thermal analysis system, an ultrasonic inspection system, an acoustic emission system, a high temperature bi-axial tension/torsion testing facility, a fiberoptic interferometer, a reflection polariscope used in material fabrication and characterization; structural dynamics laboratory; a space environmental simulator, a spectrometer and a CW Nd laser for space propulsion research.

DEPARTMENT OF AEROSPACE ENGINEERING

LABORATORY DIRECTOR

The Laboratory Director assists the Aerospace faculty, staff, and students as needed in all technical aspects of instructional, academic and research related laboratory activities. This position is presently filled by Mr. Richard Auhl, located in 226 Hammond Building. His areas of responsibilities include but are not limited to the following:

- Assist the Department Head with the implementation of department management strategies, staff software training, information systems development and strategic planning.
- Assist the faculty with undergraduate laboratory course instruction. (Aersp 305W)
- Coordinate the laboratory facility and department space allocation.
- Provide engineering and fabrication advice or assistance to faculty and students involved in project activity.
- Supervise the part-time laboratory assistants involved in general department maintenance.
- Serve as the primary contact person for the Dean's Office with regard to department space and facilities management.
- Coordinate and supervise all Machine Shop activities.
- Serve as the laboratory safety officer.

IT MANAGER

The IT Manager assists the Aerospace faculty, staff, and students as needed in technical aspects of computer and general electronics systems. This position is currently filled by Mr. Mark Catalano, located in 226 Hammond Building. His primary responsibilities are listed below in order of their importance to the department:

- Maintain and support all computer and network related equipment in the department.
- Responsible for upgrading the hardware and software of all computers in department.
- Provide purchasing support to department on computer/electronic related equipment.
- Responsible for the installation of new electronic equipment in the department.
- Responsible for maintaining the card reader system in computer lab.
- Provide classroom support for A/V equipment when student aid is not available.

Please feel free to contact Rick Auhl (777-5381, rraaer@engr.psu.edu) or Mark Catalano (777-5703, mac9@psu.edu) if you have any questions on the use of department laboratory and computer facilities or anything related to the areas mentioned above.