Undergraduate Handbook

University of Kansas
School of Engineering
Department of
Aerospace Engineering

Department Chair:
Richard Hale
Administrative Office:
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Chair's Letter

Welcome to the University of Kansas and the Department of Aerospace Engineering.

Most likely, you have entered our program because of your fascination with things that fly - aircraft, spacecraft, balloons, etc. You share this fascination with all the department faculty and alumni. Some of you might be interested in the problems associated with flight in the atmosphere (Aeronautics). Others will be interested in problems associated with operation in space (Astronautics). The Bachelor of Aerospace Engineering will prepare you for a career in either path. The program is designed to provide you with the basic understanding of the physical world, the mathematics needed to model and analyze these problems, as well as the specific technology that applies these ideas and principles to aerospace vehicles and systems.

Because you are preparing for a 40-year career and no one can imagine what new challenges and opportunities you will face, this program must emphasize the concepts and methods that will always be important, i.e. the laws of nature and mathematical methods. Unfortunately, it is impossible to learn in four years all you will need during your career. You should consider this program as the start of a lifelong experience of education and discovery. The faculty goal is to help you develop the ability and confidence to build on these basic principles to learn what is needed to be successful in the Aerospace Industry.

When you have completed the program and earned your BS, you will be able to enter industry, government organizations including NASA, a branch of the military or continue your education in graduate programs. The purpose of this handbook is to clearly identify the resources, the academic program, the graduation requirements, and the department rules and procedures that define the Aerospace Engineering Program. A similar handbook is available which defines all the graduate programs offered by the department. If you have a question about the program, first look in this handbook. If this does not provide a satisfactory answer, contact your advisor or see me.

Again, welcome.

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Section 1: Department Overview

1.1 Department History

The Kansas Board of Regents approved the Bachelor of Science in Aerospace Engineering degree in 1941. Since the first graduating class in 1944, the department has graduated over 1000 students. The BS in Aerospace Engineering has been continuously accredited by the Engineering Council for Professional Development and the Accreditation Board of Engineering and Technology, Inc. The review by the Accreditation Board assures the quality of the program. The department also offers graduate programs at both the Master and Doctoral levels. The department Advisory Board, made-up of representatives from industry, academia, and the government, annually reviews the department programs. This review assures that graduates of our programs meet the needs of the profession.

1.2 General Description of BS Program

The focus of the BS program in Aerospace Engineering is the design of aerospace vehicles and components. This is accomplished in a four-year academic program. The 1st year consists of basic sciences, mathematics, and communication courses. These courses form the key foundation for the rest of the program. In addition, you will take an Introduction to Aerospace Engineering course that will give you an overview of the BS program. In the second year, you will continue to take basic mathematics and science as well as engineering science courses. The engineering science courses apply the principles you have mastered in the basic sciences and mathematics to the solution of engineering problems. In the third year, you learn the unique nature of aerospace problems. These courses cover the major disciplines within Aerospace Engineering - fluid mechanics and aerodynamics, propulsion, structures, and flight dynamics. You will also have courses in complementary topics including computer graphics and instrumentation. In your fourth year, you have the opportunity to see how all the individual specialized technologies are used to design a vehicle.

Throughout the program, you have the opportunity to take elective courses from the College of Liberal Arts and Sciences. These are referred to as KU Core electives. You will take Aerospace Colloquium for eight semesters in the program. This course is a seminar series in which practicing engineers from industry or government organizations present lectures based upon their experiences, which give you a feel for the Aerospace Engineering profession.

1.3 Aerospace Engineering Faculty

Emily Arnold, Assistant Professor (Ph.D., University of Kansas)
Multifunctional Structures, Airborne Remote Sensing, Unmanned Aircraft Systems
2119A Learned Hall, 785-864-2467, earnold@ku.edu

Ronald Barrett-Gonzalez, Professor (Ph.D., University of Kansas)
Adaptive Aerostructures, Enhancement of Transportation Related Technologies, Missiles and Munitions
2124 Learned Hall, 785-864-2226, barrettr@ku.edu

Haiyang Chao, Assistant Professor (Ph.D., Utah State University)
Estimated and Control of Autonomous Aerospace Vehicles, Cooperative Sensing and Control, Small Unmanned Aircraft Systems
2130 Learned Hall, 785-864-2968, chaohaiyang@ku.edu

Dongkyu Choi, Assistant Professor (Ph.D., Stanford University)
Artificial Intelligence, Intelligent Agent Architectures, Robotics
2117B Learned Hall, 785-864-2924, dongkyuc@ku.edu

Mark Ewing, Associate Professor (Ph.D., Ohio State University)
Structural Vibrations of High Performance Structures, Aircraft Structural Acoustics, Interior Noise Reduction
2118B Learned Hall, 785-864-2964, mewing@ku.edu

Saeed Farokhi, Professor (Ph.D., Massachusetts Institute of Technology)
Propulsion Systems, Flow Control, Renewable Energy: Wind Turbines, Computational Fluid Dynamics
2120D Learned Hall, 785-864-2966, sfarokhi@ku.edu

Richard Hale, Professor, Associate Director of CReSIS, and Department Chair (Ph.D., Iowa State University)
Composite Materials and Structures, Uninhibited Air Vehicles, Experimental Stress Analysis
2119B Learned Hall, 785-864-2949, rhale@ku.edu

Shawn Keshmiri, John E. And Winifred Sharp Professor and Associate Professor (Ph.D., University of Kansas)
Nonlinear Parameter and System Identification, Flight Testing Unmanned Aerial System, Nonlinear Dynamic Planning and Optimization
2117A Learned Hall, 785-864-2974, keshmiri@ku.edu

Craig McLaughlin, Associate Professor (Ph.D., University of Colorado at Boulder)
Satellite Drag and Aeronomy, Orbit Determination and Astrodynamics, Space Surveillance
2119D Learned Hall, 785-864-2967, craigm@ku.edu

Ray Taghavi, John E. And Winifred Sharp Professor and Associate Chairperson (Ph.D., University of Kansas)
Fluid Mechanics, Aerodynamics, Rocket Propulsion
2118D Learned Hall, 785-864-2973, rtaghavi@ku.edu

ZJ Wang, Spahr Professor (Ph.D., University of Glasgow)
Computational Fluid Dynamics, Adaptive High-Order Methods
2120B Learned Hall, 785-864-2440, zjw@ku.edu

Huixuan Wu, Assistant Professor (Ph.D., Johns Hopkins University)
Experimental Fluid Mechanics, Turbulence and Stochastic Process, Applied Optics
2119C Learned Hall, 785-864-2970, hwu@ku.edu

Zhongquan Charlie Zheng, Professor (Ph.D. Old Dominion University)
Aerodynamics, Vortex Dynamics, Computational Fluid Dynamics & Heat Transfer
2118C Learned Hall, 785-864-2904, zzheng@ku.edu

1.4 Advising System

All students are assigned an advisor when they join the department. This advisor will normally continue to advise the same students throughout the BS program. A student can request a change in advisor through the Department administrative assistant. The Degree Progress Report form that is accessible via the myKU Portal on the internet documents student progress. Each student will see their advisor at least once a semester during pre-enrollment for the following semester. Advisors are available for consultation on any topic related to the student's activities at KU. In particular, students are encouraged to see their advisor as soon as a problem or concern is identified. This assures that all the student services provided by the university (e.g. career counseling, tutoring, and study workshops) are utilized as needed during the student's career at KU. If for any reason a student cannot reach their advisor, the student can always make an appointment with the Department Chair.

1.5 Scholarships

All first-time, domestic students applying for admission to the School of Engineering will be considered for scholarships if they apply to the School of Engineering by November 1. Scholarships for upperclassmen are also available through the Aerospace department. The deadline for application is April 1 of each year.

1.6 Cooperative Programs

Since all Aerospace Engineering courses are taught only once each academic year, it has not been possible to setup standard cooperative programs, i.e. alternate semesters of academic course work and work periods. If a student were to miss a semester in the junior or senior year at least one semester would be added to their program in addition to the time lost during the work assignment. Students interested in Cooperative Programs should talk to their advisor as soon as possible.

1.7 Employment Opportunities and Placement Services

Aerospace Engineers are employed by a wide range of industries and organizations. Typical examples are:

Aircraft and Spacecraft Manufacturers
Aircraft and Spacecraft Operators
Research Labs: NASA, Federal Aviation Administration, Department of Defense
Armed Forces: U.S. Air Force, U.S. Navy, U.S. Marine Corps, U.S. Army, U.S. Coast Guard
Aerospace Component Manufacturers
Automobile Manufacturers
Academia
Engineering Consulting Companies

Employment opportunities in engineering, in general (but in Aerospace Engineering in particular), are cyclic. It is a fact, however, that even in poor times, unemployment among engineers is, typically, the lowest of all occupations. This is because an engineer is trained to solve problems (almost any type of problem) - in a logical fashion. This capability is desired by industry and government regardless of the type of engineering degree a person has. For that reason, engineers of all types find it easy to shift into jobs not requiring engineering backgrounds at all, if they so desire.

Students seeking permanent, as well as, summer jobs are encouraged to use the Engineering Career Center (ECC) in room 1410 LEEP2. The ECC provides individual career counseling and conducts career workshops to help prepare students for interviewing and resume preparation. They also assist students in setting up appointments with companies and other organizations that conduct on campus interviews.

1.8 Student Organizations

The University offers a wide variety of student organizations the aerospace engineering students can join. Student organizations of particular interest to aerospace engineering students are listed below:

American Institute for Aeronautics and Astronautics (AIAA)

The aerospace professional society on campus is the AIAA. There is an active student branch at the University of Kansas, which organizes technical and social meetings throughout the academic year. It is highly recommended that aerospace students become active in AIAA for status in the profession, career development and career motivation.

Microgravity Team (MGT)

The KU Microgravity Team helps organize students into groups to work on projects and to assist in the application process for the Reduced Gravity program at NASA. The Reduced Gravity Student Flight Opportunities Program provides a unique academic experience for undergraduate students to successfully propose, design, fabricate, fly and evaluate a reduced gravity experiment of their choice at the NASA Johnson Space Center.

Sigma Gamma Tau (SGT)

SGT is the aerospace engineering national honor society in which membership is by invitation only. Students with exceptional scholastic performance are eligible for membership and will be invited by the campus chapter. Technical and social meetings are held throughout the academic year.

Society of Women Engineers (SWE)

The Society of Women Engineers is a national, professional, educational organization of engineers, and men and women with equivalent engineering experience, dedicated to the advancement of women in the engineering profession. There is an active student chapter of SWE on campus open to all engineering students and faculty who are interested in the goals of the organization.

Tau Beta Pi

Membership is by invitation only in this engineering national honor society. Students with exceptional scholastic performance in all engineering disciplines are eligible for membership and will be invited by the campus chapter.

Jayhawk Rocket Design

Jayhawk Rocket Design designs, constructs, and shoots off both model and high powered rockets. Projects include: full attitude control rockets, small hybrid rocket motors, and traditional high powered rockets.

Physics & Engineering Student Organization (PESO)

PESO promotes the pursuit of both physics and engineering for all students. This is a multi-disciplinary group that focuses on the project-based science and engineering tasks that contribute to a wider learning experience for the students in the group. Projects include 3D printing, small-scale wind tunnels, motion controlled laser-harp, tesla coils, jet engines and many more.

Unmanned Aerial Vehicle KU Student Organization

UAV KU Student Organization is focused on the learning and development of unmanned aerial vehicles. They are committed to furthering the fields of small aircraft design, construction, programming, navigation, and control.

Jayhawk Aero Design

Our goal is to give undergraduate students the ability to design, build, and fly (DBF) an aircraft that will be used to compete in competition. Team members will master the design process by focusing on a specific element of the design, such as; aerodynamics, propulsion, structures, etc. Additionally, each spring we will travel for competition with universities around the World.

KU Remote Operated Submersibles (KUROS)

A club for the research and development of remote operated submersibles. The robots created will be used for recreational and competitive purposes.

1.9 Faculty and Student Responsibilities

At the start of a university career students quickly discover that life in college is very different from life in high school. Students at a college or university are rightly treated as adults. Much of what you do will be your responsibility. The faculty and staff will not monitor your progress or performance. They will provide any assistance you need but generally, you will have to request help. You will prosper or fail due to your own actions. To assist you in this new environment, a clear definition of your responsibilities and those responsibilities of the faculty is useful.

Consider first the responsibilities of the faculty. Each professor may use a different set of guidelines or rules in running a class. It is the faculty's responsibility to define the rules to be used in terms of attendance, grading policy, assignments, and class schedule. If a faculty member does not provide this information or if the rules or procedures are unclear, it is recommended the student discuss this with the faculty member.

Next, consider the student's responsibilities. Once the faculty defines the course requirements, it is the student's responsibility to follow the guidelines including attending lectures and laboratories on time, submitting assignments on time, and taking all examinations. If for any reason, the student will not be able to attend class or take a test it is expected that the student notify the professor **before the absence**. Although there is no single set of rules for handling such situations, each faculty member has a set of rules. It is also the student's responsibility to obtain the information and course material presented when the student failed to attend a lecture. This includes changes in assignments or test dates. Your professor may be willing to provide this information if the absence had prior approval or if it involved an emergency.

Each student is expected to use their initiative in utilizing the university libraries and related material available in other facilities as needed. There are workshops and special lectures available to show students how to use the extensive resources provided by the university and it is the student's responsibility to seek help.

2.1 Academic Misconduct

The AE Department regards academic misconduct as a very serious matter. Students who violate conduct policies will be subject to severe penalties, up to and including dismissal from the School of Engineering. Please refer to the KU Policy Library website under Academic at http://www.policy.ku.edu/ and the School of Engineering handbook for specific guidelines about actions considered to be academic misconduct and the repercussions of such action.

These actions include, but are not limited to disruption of classes, threatening an instructor or fellow student in an academic setting; giving or receiving of unauthorized aid on examinations or in the preparation of notebooks, themes, reports or other assignments; knowingly misrepresenting the source of any academic work; unauthorized changing of grades; unauthorized use of University approvals or forging of signatures; falsification of research results; plagiarizing of another's work; violation of regulations or ethical codes for the treatment of human and animal subjects; or otherwise acting dishonestly in research.

Section 2: Admission

2.1 Admission Directly From High School

Students may enter the Department of Aerospace Engineering as freshmen, but all admissions (both in state and out-of-state), are on a selective basis. General requirements for admission to the University are included under Admission in the General Information section of the Undergraduate catalog. Students from foreign institutions are not accepted directly into the school, but may apply for transfer after at least one semester in the College of Liberal Arts and Sciences or in some other U.S. institution.

To be considered for admission to the Department of Aerospace Engineering, all applicants must meet or exceed minimum academic standards. Admission is on a competitive basis following a review of an individual's achievements considering factors such as high school record, class standing, scores on national tests, advisor recommendation, and trend of grades. High school transcripts and ACT scores (or equivalent SAT scores) are required.

Minimum Academic Standards for Admission:
To be considered for admission to the Department of Aerospace Engineering, beginning first-year students must meet or exceed the following minimum standards:

- Have a 3.0 grade-point average on a 4.0 scale
- Have a mathematics ACT score of 26+ (or math SAT score of 620+)

Important: Simply meeting these requirements will not guarantee admission to the Department of Aerospace Engineering. Students who perform beyond these minimums will have a better probability of being admitted.

2.2 Admission as a Transfer Student

Students who wish to transfer into the BS in Aerospace Engineering program from other institutions are evaluated on a case-by-case basis. Transfer students must have a college grade-point average of 2.5 or higher to be considered. Students must submit mathematics ACT or SAT scores or proof of competence in calculus (grade of C or higher).

Transfer credits for all courses are evaluated by the Office of Admissions. Transfer credits will be further reviewed at the time of initial advising by the Aerospace Engineering Department. Only courses in which a grade of C or better was obtained will be granted transfer credit. Courses graded Pass/Fail will not be granted transfer credit. No upper-level engineering credits from non-ABET-accredited engineering programs are acceptable as transfer credit for engineering programs. All transfer students must take their last 30 hours of credits while enrolled in the KU School of Engineering to be eligible to graduate from the University of Kansas.

Students currently enrolled in another school at the University of Kansas who wish to transfer to the department of Aerospace Engineering must fill out a Change of School form. Students within the School of Engineering that would like to transfer to the department of Aerospace Engineering must fill out a Change of Major form. The student must then submit the form to the School of Engineering Student Success Suite in 1415 LEEP2.

Section 3: Graduation Requirements

3.1 General Requirements

To graduate with the Bachelor of Science degree in Aerospace Engineering the student must complete a published curriculum in effect at the time of entry or beyond. This curriculum consists of a distribution of required courses in English, mathematics, basic sciences, engineering sciences, and Aerospace Engineering. In addition to these required courses, each candidate must take approved Technical Electives and approved KU Core electives. The student must complete the required courses with at least a 2.0 grade point average in all courses taken at KU as well as at least a 2.0 grade point average in all engineering courses taken at KU. The student must also take 30 hours of credit while enrolled in the KU School of Engineering.

Note: The curriculum is constantly under review by the faculty and may change during a four-year period. For this reason, a student can select any published curriculum in effect from the time of their entry in the program to the program in effect at the time of graduation. The student should notify their advisor which program is to be used and all the requirements listed in this published program must be satisfied.

3.2 Specific Requirements for BS Degree in Aerospace Engineering

The program requirements for students entering the program in Fall 2017 and later are detailed in Table 3.1. Rigid prerequisites exist for each course. This is to insure that students are adequately prepared to take a specific course. Detailed descriptions of required courses can be found in the University's undergraduate catalog.

Table 3.2 presents the recommended 4-year sequence of courses. This is the recommended sequence for students who are prepared to enter the program directly, and who are full-time students without other time consuming activities, e.g. part-time work, ROTC, intercollegiate sports, band, or other student activities. Many students who are involved in nonacademic, time-consuming activities take more than 4 years to graduate. A typical 5-year sequence of courses is given in Table 3.3 as a guide. Students who believe they may plan to take more than 4 years are strongly advised to discuss this with their advisor or the Department Chair. Note that many courses may be taken in the summer at either KU or other universities and junior colleges.

A total of 133 credit hours is typical for the B.S. Degree in Aerospace Engineering as shown in Table 3.1.

3.3 Requirements for Enrollment in Junior Level Aerospace Courses

Enrollment in junior-level aerospace courses is limited to students who have received grades of C or higher in all first- and second-year courses in mathematics, physics, ME 312, CE 301, CE 310, AE 211, AE 245, AE 345, and AE 445.

3.4 Fall Graduation

For students who would be eligible to graduate after 4 ½ years <u>except</u> that the second design course has not been completed, it is possible to substitute for the second design course, i.e., AE 522 or AE 523 or AE 524, in the fall semester. The substitution must not only be four hours but also must have four hours of design activity equivalent to the second design courses. The recommended substitution is AE 721 - Aircraft Design Laboratory I. Both the student's advisor and the department Chair must approve any other substitution. Students who plan to take these options and graduate in December are urged to discuss this with their advisor as soon as possible.

3.5 Credit / No Credit and Correspondence Courses

The department does not permit the use of any Credit/No Credit or correspondence courses to fulfill degree requirements. This applies to courses taken at KU or at other institutions. The only exceptions are AE 241, 242, and 441 in special circumstances.

3.6 Dual Degrees

Some students, because of a broad interest or specific career plan, elect to pursue two Bachelor's degrees simultaneously. In such cases, the student must satisfy the requirements of both degrees. This must also involve an additional 30 hours of credit beyond the first degree. Because of the desire to minimize the time and effort of the student and due to the complexities involved, it is strongly recommended the student make their plans known to their advisor. In addition, the student should coordinate their program with an advisor from the second department.

3.7 Co-Enrollment in the BS and Graduate Programs

Often, students in the last semester of their BS program will not have a full course load. These students can enroll in up to 6 hours of graduate courses that will count toward the Master of Science in Aerospace Engineering Degree. To be co-enrolled, the student must apply and be accepted in the graduate program. In addition, the student must announce to both their advisor and the Department administrative assistant which courses are to be used to complete the requirements for the BS and which courses should be counted toward the Master of Science degree.

3.8 Graduating with Departmental Honors

In order to graduate from the Aerospace Engineering program with honors, students must have a KU GPA of 3.5 or higher and take at least one department honors course. Department honors courses include: AE 546, AE 573, AE 509, AE 552, and AE 593.

Table 3.1 Required Courses for BS Degree in Aerospace Engineering

Engineering Courses (76 hours)		**Hours**
AE 245	Introduction to Aerospace Engineering (Goal 2.2 and 5)	3
AE 290	Aerospace Colloquium (Goal 5)	2
AE 345	Fluid Mechanics	3
AE 360	Introduction to Astronautics	3
AE 421	Aerospace Computer Graphics (Goal 2.2)	3
AE 430	Aerospace Instrumentation Lab	3
AE 445	Aircraft Aerodynamics & Performance	3
AE 507	Aerospace Structures I	3
AE 508	Aerospace Structures II	3
AE 510	Aerospace Materials & Processes (Goal 2.2 and 5)	4
AE 521	Aerospace Systems Design I (Goal 5 and 6)	4
AE 522	Aerospace Systems Design II (Goal 2.2 and 6) \	
OR		
AE 523	Spacecraft Design (Goal 2.2 and 6)	4
OR		
AE 524	Propulsion System Design (Goal 2.2 and 6) /	
AE 545	Fundamentals of Aerodynamics	4
AE 550	Dynamics of Flight I	4
AE 551	Dynamics of Flight II	4
AE 571	Fundamentals of Aircraft Reciprocating Propulsion Systems	3
AE 572	Fundamentals of Jet Propulsion	3
AE 590	Aerospace Senior Seminar (Goal 5)	1
AE 211	Computing for Engineers	3
CE 301	Statics & Dynamics	5
CE 310	Strength of Materials	4
ME 312	Basic Engineering Thermodynamics	3
EECS 316	Circuits	3
EECS 318	Circuits Laboratory	1
Science and Mathematics Courses (30 hours)		
CHEM 150/130	Chemistry for Engineers (Goal 3N)	5
PHSX 210	General Physics I (Goal 1.1)	3
PHSX 216	General Physics I Laboratory	1
PHSX 212	General Physics II	3
PHSX 236	General Physics II Laboratory	1
MATH 125	Calculus I (Goal 1.2)	4
MATH 126	Calculus II	4
MATH 127	Calculus III	4
MATH 220	Differential Equations	3
MATH 290	Linear Algebra	2
Other Required and Elective Courses (27 hours)		
KU Core Electives (Goals 2.1 (x2), 3H, ECON, 4.1 and 4.2)		18
Technical Electives		9
	Grand Total	133

Table 3.2 Recommended 4 Year Course Sequence for BS in Aerospace Engineering

Freshman Year

Fall			Spring		
MATH 125	Calculus I*	4	MATH 126	Calculus II*	4
CHEM 150	Chemistry for Engineers****	5	PHSX 210	Physics I*	3
AE 245	Intro to Aero Engineering*	3	PHSX 216	Physics I Lab	1
AE 290	Aerospace Colloquium	.25	AE 290	Aerospace Colloquium	.25
	KU Core Written Communications**	3	AE 211	Computing for Engineers*	3
		15.25		KU Core Written Communications**	3
				KU Core Elective**	3
					17.25

Sophomore Year

Fall			Spring		
MATH 220	Applied Differential Equations*	3	AE 445	Aerodynamics & Performance*	3
CE 301	Statics & Dynamics*	5	AE 360	Intro to Astronautics	3
PHSX 212	Physics II*	3	MATH 127	Calculus III	4
PHSX 236	Physics II Lab	1	CE 310	Strength of Materials	4
AE 345	Fluid Dynamics*	3	ME 312	Thermodynamics*	3
AE 290	Aerospace Colloquium	.25	AE 290	Aerospace Colloquium	.25
	KU Core Elective**	3			17.25
		18.25			

Junior Year

Fall			Spring		
AE 507	Aerospace Structures I	3	AE 508	Aerospace Structures II	3
AE 550	Dynamics of Flight	4	AE 551	Dynamics of Flight II	4
MATH 290	Elementary Linear Algebra*	2	AE 572	Jet Propulsion	3
AE 571	Reciprocation Propulsion	3	AE 421	Aero Computer Graphics	3
AE 545	Aerodynamics	4	EECS 316	Circuits, Elec. & Inst	3
AE 290	Aerospace Colloquium	.25	EECS 318	Circuits, Elec. & Instr Lab	1
		16.25	AE 290	Aerospace Colloquium	.25
					17.25

Senior Year

Fall			Spring		
AE 521	Aircraft Design I	4	AE 522/3/4	Design II	4
AE 510	Materials & Processes	4	AE 430	Aerospace Instrumentation	3
AE 590	Aerospace Senior Seminar	1	AE 290	Aerospace Colloquium	.25
AE 290	Aerospace Colloquium	.25		Tech Electives***	6
	Tech Elective*** or AE 560*****	3		KU Core Elective**	3
	KU Core Elective**	3			16.25
		15.25			

*Students must pass with C or higher for course to count towards degree.
**Students must ensure the electives they choose fulfill all remaining KU Core requirements.
***Technical electives are selected from upper level aerospace courses, approved courses from other engineering departments or approved math courses.
****Chemistry 130 can be substituted for Chemistry 150.
*****AE 560 is offered to students who will be taking AE 523 as their Design II requirement.

Table 3.3 Recommended 5 Year Course Sequence for BS in Aerospace Engineering

First Year

Fall			Spring		
MATH 125	Calculus I*	4	MATH 126	Calculus II*	4
AE 245	Intro to Aerospace*	3	PHSX 210	Physics I *	3
AE 290	Aerospace Colloquium	.25	PHSX 216	Physics I lab	1
	KU Core Written Communications**	3	AE 290	Aerospace Colloquium	.25
	KU Core Elective**	3	AE 211	Computing for Engineers*	3
		13.25		KU Core Written Communications**	3
					14.25

Second Year

Fall			Spring		
MATH 220	Applied Differential Equations*	3	ME 312	Thermodynamics*	3
AE 345	Fluid Mechanics*	3	CE 310	Strength of Materials*	4
CE 301	Statics & Dynamics*	5	MATH 127	Calculus III	4
PHSX 212	Physics II*	3	AE 445	Aerodynamics & Performance*	3
PHSX 236	Physics II Lab	1	AE 290	Aerospace Colloquium	.25
AE 290	Aerospace Colloquium	.25			14.25
		15.25			

Third Year

Fall			Spring		
AE 507	Aero Structures I	3	AE 508	Aero Structures II	3
MATH 290	Elementary Linear Algebra*	2	EECS 316	Circuits, Elec. & Inst	3
CHEM 150	Chemistry for Engineers*****	5	EECS 318	Circuits, Elec. & Inst	1
AE 290	Aerospace Colloquium	.25	AE 360	Intro to Astronautics	3
	KU Core Elective**	3	AE 290	Aerospace Colloquium	.25
		13.25		KU Core Elective**	3
					13.25

Fourth Year

Fall			Spring		
AE 550	Dynamics of Flight I	4	AE 551	Dynamics of Flight II	4
AE 571	Reciprocating Prolusion	3	AE 572	Jet Propulsion	3
AE 545	Aerodynamics	4	AE 421	Computer Graphics	3
AE 290	Aerospace Colloquium	.25	AE 430	Aerospace Instrumentation	3
	KU Core Elective**	3	AE 290	Aerospace Colloquium	.25
		14.25			13.25

Fifth Year

Fall			Spring		
AE 521	Aircraft Design I	4	AE 522/3/4	Design II	4
AE 510	Materials & Manufacturing	4		Tech Electives***	6
AE 590	Senior Seminar	1			13
	Tech Elective*** or AE 560*****	3			
		12			

*Students must pass with C or higher for course to count towards degree.
**Students must ensure the electives they choose fulfill all remaining KU Core requirements.
***Technical electives are selected from upper level aerospace courses, approved courses from other engineering department or approved math courses.
****Chemistry 130 can be substituted for Chemistry 150.
*****AE 560 is offered to students who will be taking AE 523 as their Capstone requirement.

Section 4: KU Core

4.1 Purpose

The KU Core establishes six educational goals for all undergraduates at the University of Kansas. The KU Core is designed to yield fundamental skills, build a broad background of knowledge, generate capacities and opportunities for blending and creating ideas, strengthen an appreciation of cultural and global diversity, and cultivate ethical integrity.

The KU Core is not a prescribed set of courses that students must take. Hundreds of courses and experiences have been approved as part of the KU Core. Students can select the courses or experiences that match their interests and areas of study. This selection allows each student to create a unique undergraduate experience.

4.2 Fulfilling the KU Core

Goal 1, Outcome 1, Critical Thinking: PHSX 210
Goal 1, Outcome 2, Quantitative Literacy: MATH 125
Goal 2, Outcome 1, Written Communications: Meet via KU Core requirements
Goal 2, Outcome 2, Oral Communications: AE 245, 421, 510 **AND** 522, 523, 524, or 721
Goal 3, Outcome 1, Arts and Humanities: Meet via KU Core requirements
Goal 3, Outcome 2, Natural Science: CHEM 150 or CHEM 130
Goal 3, Outcome 3, Social Sciences: ECON 104, 142, or 144
Goal 4, Outcome 1, Diversity in the United States: Meet via KU Core requirements
Goal 4, Outcome 2, Global Awareness: Meet via KU Core requirements
Goal 5, Outcome 1, Ethics and Social Responsibility: AE 245, 290, 510, 521, **AND** 590
Goal 6, Outcome 1, Capstone: AE 521 **AND** 522, 523, 524, 721

Details of the KU Core can be found at kucore.ku.edu. Some required courses in the AE curriculum satisfy a KU Core goal and/or outcome. For these courses, the goal/outcome code is given in parentheses after the course on the pages above. Where required courses do NOT specifically satisfy KU Core goals (Goals 2.1, 3H, and 4) students must choose from a list of several means to satisfy the required goals. Transfer students who may not be able to complete the sequences for Goals 2.2 and 5 should talk to their advisor about alternate ways to fulfill those Core goals.

Section 5: Technical Electives

5.1 Purpose

The purpose of the Technical Elective courses is to allow the student to select advanced courses in one or more areas that are of special interest. Each student must take at least 9 hours of Technical Electives, of which a minimum of 3 hours must be Aerospace Engineering courses. The satisfaction of this requirement can be accomplished by several methods as listed below.

5.2 Suggested Technical Electives

Table 5.1 lists courses that have been reviewed by the Aerospace Faculty and are approved for use as Technical Electives. A maximum of 3 hours of AE 592 can be used as a technical elective. The student is responsible for either verifying that all prerequisites are satisfied or that permission is received from the instructor. The student should be aware that not all courses listed in Table 5.1 are available each semester. For detailed descriptions of the Aerospace Engineering courses see ae.engr.ku.edu/courses.

5.3 Focus Area

The department recognizes, however, that some students would like to focus their technical electives on one aspect of aerospace engineering. To help students select their technical electives, the department has compiled lists of appropriate courses that form focus areas. Table 5.2 contains recommended courses for focus areas in Aerodynamics, Propulsion, Structures, Flight Dynamics and Control, Vehicle Design, Astronautics, and Manufacturing. It is also possible for a student, working with an advisor, to create other focus areas.

5.4 Course Substitution Petition

If a student wants to take a course not listed in Table 5.1 as a Technical Elective, the student needs the approval of their advisor and must document this by filing a Course Substitution Petition with the department administrative assistant. The form must be signed by their advisor. This form will be filed in the student's academic folder.

5.5 Reserve Officer Training Corps (ROTC)

A student enrolled in one of the ROTC programs can receive 3 hours of Technical Electives credit if the ROTC program is completed. If the student does not complete the ROTC program, no Technical Elective credits are awarded. Students in ROTC may not use flight training courses (e.g. AE 241 and 441) to satisfy Tech Elective requirements.

5.6 Mathematics Minor

A Mathematics minor consists of 18 hours of math courses, 12 hours of which must be numbered 300 and above, excluding MATH 365. This means that a student needs to take 4 courses more than those required for the AE BS degree. Therefore, a student who elects to take 6 hours of Mathematics as a Technical Elective would only need two extra Mathematics courses beyond the AE BS degree.

Table 5.1 Approved Technical Electives

The following courses are approved as Technical Electives for the BS program.

AE	241	Private Flight Course (1)
AE	441	Advanced Flight Training (1-3)
AE	560	Spacecraft Systems (3)
AE	592	Special Projects in Aerospace Engineering* (1-3)
AE	670	Aerospace Propulsion III (3)
AE	701	Structural Design (3)
AE	704	Dynamics and Vibrations (3)
AE	705	Structural Vibrations and Modal Testing (4)
AE	707	Aerospace Structural Loads (3)
AE	708	Aerospace Structures III (3)
AE	709	Structural Composites (3)
AE	710	Advanced Structural Composites (3)
AE	712	Techniques of Engineering Evaluation (3)
AE	713	Stochastic Systems, Estimation and Identification in Aerospace Engineering (3)
AE	721	Aircraft Design Laboratory I (4)
AE	722	Aircraft Design Laboratory II (4)
AE	724	Propulsion System Design & Integration (3)
AE	725	Numerical Optimization & Structural Design (3)
AE	730	Advanced Experimental Fluid Dynamics (3)
AE	731	Supersonic Aerodynamics Laboratory (1)
AE	732	Flight Test Principles & Practice (3)
AE	743	Compressible Aerodynamics (3)
AE	744	Introduction to Turbulent Flow (3)
AE	745	Applied Wing and Airfoil Theory (3)
AE	746	Computational Fluid Dynamics (3)
AE	747	Transonic Aerodynamics (3)
AE	748	Helicopter Aerodynamics (3)
AE	750	Applied Optimal Control (3)
AE	751	Advanced Airplane Dynamics (2)
AE	752	Linear Multivariable Control (3)
AE	753	Digital Flight Controls (3)
AE	754	Missile Dynamics (3)
AE	756	Rule-Based Control Systems (3)
AE	757	Rule-Based UAV Control Lab (1)
AE	758	Introduction to Robotics (3)
AE	759	Estimation and Control of Unmanned Autonomous Systems (3)
AE	760	Spacecraft Systems (3)
AE	765	Orbital Mechanics (3)
AE	766	Spacecraft Attitude Dynamics and Control (3)
AE	767	Spacecraft Environments (3)
AE	768	Orbit Determination (3)
AE	771	Rocket Propulsion (3)
AE	772	Fluid Mechanics of Turbomachinery (3)
AE	781	Introduction to Adaptive Aerostructures (3)
AE	790	Special Problems in Aerospace Engineering (1-3)
AE	941	Hypersonic Aerodynamics I (3)

Table 5.1 Approved Technical Electives (Continued)

MATHEMATICS

MATH	526	Applied Mathematical Statistics I (3)
MATH	542	Vector Analysis (2)
MATH	590	Linear Algebra (3)
MATH	627	Probability (3)
MATH	628	Mathematical Theory of Statistics (3)
MATH	646	Complex Variables and Applications (3)
MATH	647	Applied Partial Differential Equations (3)
MATH	648	Calculus of Variations (3)
MATH	650	Nonlinear Dynamical Systems (3)
MATH	735	Introduction to Optimal Control Theory (3)
MATH	750	Stochastic Adaptive Control (3)
MATH	781	Numerical Analysis I (3)
MATH	865	Introduction to Stochastic Processes (3)
MATH	866	Stochastic Processes II (3)

CIVIL ENGINEERING

CE	625	Applied Probability and Statistics (3)
CE	710	Structural Mechanics (3)
CE	721	Experimental Stress Analysis (3)
CE	767	Introduction to Fracture Mechanics (3)

ELECTRICAL ENGINEERING and COMPUTER SCIENCE

EECS	360	Signal Analysis (3)
EECS	461	Probability and Statistics (3)
EECS	562	Intro to Communication Systems (4)

MECHANICAL ENGINEERING

ME	508	Numerical Analysis of Mech Engr Problems (3)
ME	612	Heat Transfer (3)
ME	708	Microcomputer Applications in Mechanical Engineering (3)
ME	770	Conductive Heat Transfer (3)
ME	774	Radiative Heat Transfer (3)

*The department does not accept internships to count towards technical elective hours.

Table 5.2 Recommended Focus Area Courses

I. Aerodynamics Focus – Coordinators: Farokhi & Zheng

AE	712	Techniques of Engineering Evaluation
AE	730	Advanced Experimental Fluid Dynamics
AE	743	Compressible Aerodynamics
AE	744	Introduction to Turbulent Flow
AE	745	Applied Wing & Airfoil Theory
AE	746	Computational Fluid Dynamics
AE	747	Transonic Aerodynamics
AE	748	Helicopter Aerodynamics
AE	772	Fluid Dynamics of Turbomachinery
AE	840	Aerodynamics of Viscous Fluids
AE	941	Hypersonic Aerodynamics I
MATH	646	Complex Variables
MATH	647	Applied Partial Differential Equations
MATH	781	Numerical Analysis I

II. Structures Focus – Coordinators: Ewing & Hale

AE	704	Dynamics and Vibration
AE	705	Structural Vibrations and Modal Testing
AE	709	Structural Composites
AE	710	Advanced Structural Composites
AE	725	Numerical Optimization and Structural Design
MATH	590	Linear Algebra
MATH	646	Complex Variables
MATH	647	Applied Partial Differential Equations
MATH	648	Calculus of Variations and Integral Equations
AE	803	Aeroelasticity

III. Propulsion Focus – Coordinators: Farokhi & Taghavi

AE	724	Propulsion System Integration Design
AE	771	Rocket Propulsion
AE	772	Fluid Mechanics of Turbomachinery
ME	612	Heat Transfer
MATH	646	Complex Variables
MATH	647	Applied Partial Differential Equations
MATH	781	Numerical Analysis I

IV. Configuration Design Focus – Coordinator: Barrett

AE	522	Aero Systems Design II
AE	721	Aircraft Design Laboratory I
AE	722	Aircraft Design Laboratory II

Table 5.2 Recommended Focus Area Courses (continued)

V. Dynamics & Control Focus – Coordinator: Keshmiri

AE	713	Stochastic Systems, Estimation and Identification in Aerospace Engineering (3)
AE	750	Applied Optimal Control
AE	751	Advanced Airplane Dynamics
AE	752	Linear Multivariable Control
AE	753	Digital Flight Controls
AE	754	Missile Dynamics
AE	755	Robust Control of Nonlinear Systems
AE	756	Rule-Based Control Systems
AE	757	Rule-Based UAV Control Lab
AE	758	Introduction to Robotics
AE	759	Estimation and Control of Unmanned Autonomous Systems
AE	766	Spacecraft Attitude Dynamics and Control
MATH	648	Calculus of Variations and Integral Equations
MATH	650	Nonlinear Dynamical Systems (3)
MATH	735	Introduction to Optimal Control Theory (3)
MATH	750	Stochastic Adaptive Control (3)
MATH	865	Introduction to Stochastic Processes (3)
MATH	866	Stochastic Processes II (3)

VI. Manufacturing Focus – Coordinator: Hale

ME	528	Mechanical Design IB (follow-on to ME 428~AE510
ME	607	Computer Aided Manufacturing
ME	627	Automotive Design & Manufacturing
ME	706	Industrial Robotics
MATH	627	Probability
MATH	628	Statistics
BUS	637	Advanced Statistics
BUS	704	Total Quality Management
BUS	719	Operations Management

VII. Astronautics Focus – Coordinator: McLaughlin

AE	560	Spacecraft Systems
AE	760	Spacecraft Systems
AE	765	Orbital Mechanics
AE	766	Spacecraft Attitude Dynamics and Control
AE	767	Spacecraft Environments
AE	768	Orbit Determination
AE	771	Rocket Propulsion
EECS	360	Signal Analysis
EECS	461	Probabilistic Analysis
EECS	562	Introduction to Communication Systems
MATH	627	Probability
MATH	628	Mathematical Theory of Statistics

Section 6: Department Research and Facilities

6.1 Introduction

The School of Engineering and the Department of Aerospace Engineering at the University of Kansas have extensive facilities to support our undergraduate and graduate education and research missions.

All faculty members are active in funded and unfunded research. If a student is interested in becoming involved in research they should contact the appropriate faculty member. Undergraduate students can receive academic credit for research performed by enrollment in AE 592, Special Projects in Aerospace Engineering.

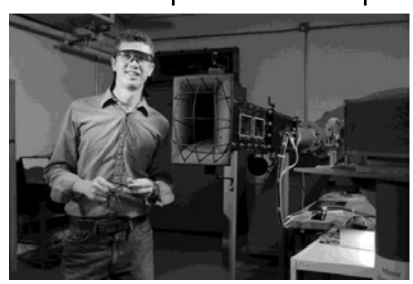
6.2 Research Facilities

Each student will have the opportunity to work with a broad range of experimental equipment as well as industry-standard computational and design software, including ANSYS FLUENT for Computational Fluid Dynamics, ASK Satellite Toolkit for orbital analysis, MSC NASTRAN/PATRAN for structural analysis, Siemens NX for detailed design, and DARCorp AAA for preliminary aircraft design.

Closed Circuit Subsonic Wind Tunnel

The Closed Circuit Subsonic Wind Tunnel, shown on the left, has a 36" by 51" test section and a maximum speed of 200 mph. This tunnel is equipped with a six-component strain-gauged balance and computerized data acquisition system. Flow visualization techniques include a laser light sheet, smoke, helium bubbles, and surface oil streak-line methods. A computerized, two-axis traversing system is available for flow field mapping. The test section and operator's station is located in Room 1180 of Learned Hall.

The Open Circuit Subsonic Wind Tunnel has a 21" by 30" test section and a maximum speed of 120 mph. This tunnel is useful for fundamental fluid mechanics experiments due to its low turbulence factor. The Department's helium bubble system can be used in this tunnel.



Supersonic Wind Tunnel

The Supersonic Wind Tunnel, pictured on the right, has a 2” by 3 ¼’ test section with a Mach number range of 1.5 to 3.0. The tunnel is a draw-down type equipped with a Schlieren system and wall static pressure ports for pressure measurements. This tunnel is located in Room 1180, Learned Hall.

The Small Water Tunnel has a 6” wide, 6” deep and 7’ long channel. Water is pumped in a closed loop. The maximum speed at the experimental section is 3ft/sec. The turbulence level is 0.5%. This facility is mainly used for education and research. It allows particle image velocimetry measurements and dye-based flow visualization. The water tunnel is located in Room G445 LEEP2.

The Structural Dynamics and Acoustics Laboratory consists of a modal test system and an acoustics data acquisition system. The Data Physics / MeScope Modal Test System is used to determine the vibratory “signature” of structures using vibration data from various sensors, including piezoceramic accelerometers. This professional-grade system is augmented by a PC-based National Instruments data acquisition system with a high speed (1M sample/sec.) 32-channel analog-to-digital board. Vibration excitation is provided by both an electrodynamic shaker and a modal hammer. The Acoustical Data Acquisition System is used to measure sound in support of structural acoustics research. The system is based on a PC with a 32-channel analog-to-digital board.

Mechanical Testing Facilities are shared with the Departments of Mechanical and Civil Engineering. These facilities provide testing capabilities for articles ranging from material coupons to large-scale structures. Available test equipment includes 222 kN and 89 kN MTS servo-hydraulic test machines, a 489 kN Instron servo-hydraulic test machine, 267 kN and 107kN Baldwin hydraulic test machines and instrumentation including extensometers, load cells, strain gages and digital data acquisition systems. Additional equipment for experimental stress analysis includes a reflection polariscope and a portable four beam Moiré interferometer.

The Composite Materials Laboratory addresses applied and developmental research in environmental remote sensing, energy and transportation. This laboratory supports researchers to design and construct aircraft, sensors and systems to enable airborne environmental remote sensing, with the primary funded research addressing ice-penetrating radar that can assist CReSIS researchers in the quest to capture data and create accurate 3-D maps of ice sheets all the way to the bedrock. Sensor suites have also been developed for fine scale measurements of terrestrial ecosystem structure and biomass. Past projects include small and large unmanned aircraft, radar arrays and fairings, wind turbine blades, telescopes and fuel containment devices. Teams of faculty, staff and students in recent years have designed, fabricated and flight-tested unmanned aircraft and manned aircraft sensor suites, predominantly for remote sensing in Greenland and Antarctica.

The composite lay-up facility is a 59 m^2 "clean" room with a 6.7 m^2 lay-up table and 24.3 m^3 of –30° C material storage. The composite tooling and processing laboratory encompasses 128.4 m^2, and contains a radial diamond saw, 17.8 cm diamond blade precision sectioning saw, 22.9 cm abrasive cutter, two hydraulic specimen mounting presses, orbital and vibrating polishers and a microhardness tester. Sample inspection and documentation is aided with a Nikon Epiphot inverted reflected light photomicroscope capable of magnification to 1000X, with Polaroid and 35mm film or digital video capture. The composite curing facility encompasses 66.3 m^2 and includes an autoclave for curing thermoset and thermoplastic composite materials, 107kN and 667 kN electrically heated water cooled platen presses, and electronically controlled ovens. The autoclave is rated to 2.4 MPa and 370° C and has a usable space of 30x30x91 cm. The smallest oven is rated to 370° C and has a usable space of 51x51x46 cm. and the intermediate oven is rated to 370C and has a usable space of 1.5m x 1 m x .8m. The composite materials laboratory also houses an electronically controlled walk-in curing oven capable of 260° C, with a usable space of 2.1 x 2 x 6.1 m.

The Cooperative Unmanned Systems Laboratory (CUSL) is a multi-disciplinary research lab at the University of Kansas (KU) that focuses on the design, development, and testing of teams of unmanned systems for cooperative sensing and cooperative control missions. The research objectives of CUSL include autonomous system development, gust/wake sensing and wind soaring using UAVs, design of cooperative sensing and estimation algorithms, and networked cyber-physical systems.

The Nondestructive Evaluation Laboratory is a shared facility with the Department of Civil Engineering. Available equipment includes a SONIX CSF1000-3X digital 3-axis automated immersion ultrasonic scanning system (pictured at left) with capabilities for A-scan, B-scan and C-scan testing in through-transmission or pulse-echo mode. Current equipment provides a scanning envelope of 0.8x0.9x1.2 m. In addition, the laboratory houses a combination digital acoustic emission acquisition and analysis, and low frequency ultrasonic generation, acquisition and analysis system. Acoustic emission and ultrasonic inspection capabilities are enhanced by state of the art data acquisition software running on PC workstations. Finally, the laboratory has an ultrasonic flaw detector. These systems are used for laboratory and field-testing and inspection of materials and structures.

Textron Aviation Aerospace Engineering Design Lab consists of a general work area equipped with 43 PC workstations with shared high-speed printer support. Specialized design software includes DARCorp AAA, MSC NASTRAN / PATRAN, ASK Satellite Tool Kit, ANSYS FLUENT and Siemens NX.

The Cognitive Control Systems Laboratory is designed as a one-stop research and development facility for small robots and unmanned aircraft. It features student workstations, a 3D printing equipment, and a protected, indoor flight range with a 14-camera VICON tracking system. Faculty and students can design, build, and operate robots and unmanned aircraft in this laboratory, while performing research for the goal of cognitively-inspired intelligent machines.

Aerospace Manufacturing Facilities
The Department of Aerospace Engineering maintains a research machine shop with two milling machines, a lathe, sheet metal break and shear equipment, band saws and drill presses. In addition, the School of Engineering maintains a fully-equipped machine shop with multiple milling machines, surface grinders, vertical and horizontal band saws, drill presses, welding equipment, and a paint booth. New acquisitions include a Stratasys Prodigy fused deposition modeling rapid prototyping center and a computer numerically controlled (CNC) mill with five axes of motion and 48" x 20" x 20" travel in translational axes.

AST 4000 Fixed Base

The Adaptive Aerostructures Laboratory (AAL) maintains unique capabilities supporting the design, fabrication and testing of aerospace structures with adaptive materials. Unlike conventional materials, adaptive materials change some property as a function of an applied control signal or stimulus. The AAL maintains a range of stocks of piezoelectric, electrostrictive, shape-memory-alloy, magnetostrictive, magnetorheological, and other adaptive materials and processing equipment. In addition to supporting work with adaptive materials, the AAL has generated many aerospace “firsts” in subscale uninhabited aerial vehicles, morphing aircraft, missles and munitions. It is currently host to a unique ballistics laboratory where guided bullets and cannon shells are being designed and tested in the 40mm x 10m and 20mm x 5 m gas guns. More than 50 subscale aircraft are housed in the 1200+ sq. feet facility as well as 9 grades of graphite-epoxy composites, 4 grades of Kevlar, composite cure oven, diamond saws and precision post processing machines.

In the Computational Thermal Fluids Laboratory we develop state-of-the art CFD algorithms and tools on modern computer platforms such as CPU and GPU clusters. In addition, we apply these tools to solver challenging fluid dynamics problems such as flow over high lift configurations, helicopters, flow inside jet engines, noise generated by moving bodies, to name just a few. Our research has been supported by AFOSR, DOE, NSF, DARPA, ARO, NASA, ONR.

The Acoustic Reverberation Suite includes two adjacent, acoustically reverberant (“echoing”) rooms with a 4-foot by 8-foot aperture (“window”) between them. The suite is designed to measure Transmission Loss (TL) for room or vehicle walls and Absorption Coefficients of sound-absorbing materials used in walls or interior furnishings. Flat or slightly curved panels are inserted into the aperture to measure the TL when sound—generated and measured in the south room—is transmitted to the north room. The difference in the measured sound pressure level (SPL) is resolved as the TL on which the panel Noise Isolation Class (NIC) rating is based. Alternatively, the acoustic absorption of objects placed in one of the rooms may be measured by comparing the room reverberation time with and without the test objects. This facility is currently primarily used to devise and evaluate alternative test methods associated with noise reduction and for testing the noise reduction qualities of panels fabricated with new materials and/or new noise reduction schemes. The types of panels to be evaluated include aircraft fuselage side-walls and new building walls. Coefficients of absorption will be measured for various architectural materials including fabric used for variable reverberation control in auditoriums and similar spaces.

The Mal Harned Propulsion Laboratory consists of a test cell capable of testing gas turbine engines up to 8,000 pounds of thrust, as well as reciprocating engines. The control room is equipped with basic engine testing instrumentation. This facility is located in the Department's hangar at the Lawrence Airport.

The Garrison Flight Research Center (GFRL) was established in 2004 with the renovation of the existing 18,000 square foot university hangar. The GFRL, now upgraded to 22,000 square feet, has a classroom, machine shop, electronics shop, offices, an AST 4000 fixed base simulator and hangar space for several aircraft. These provide resources for developing intelligent vehicle systems for the flight research of both piloted and uncrewed air vehicles. Additional shop and assembly space, along with a propulsion test cell, are available in an adjacent building, the KUAE “Hawkworks”.

The Garrison Flight Research Center houses the department’s Cessna 172 Skyhawk and Cessna 182 RG. The Cessna 172 is used both for transportation and research, while the Cessna 182 is dedicated to flight research activities. The Cessna 182 is specifically configured to accommodate in-flight test instrumentation.

Cessna 172

In addition, KUAE has recently invested in an AST 4000 Fixed Base Simulator, produced by American Simulation Technology. This flight simulator is PC based with programmable LCD Instrument Panels and programmable digital aircraft dynamic models. The “vehicle” can accommodate our experimental autopilot module, and offers an out the window projection system and built-in weather and turbulence effects with a programmable control loader. Student designed vehicles may be entered in the flight characteristics module such that vehicles may be “flown” and experienced by the design team.

Cessna 182

Appendix A: The Aerospace Engineering Advisory Board

The Advisory Board serves as an overview group for the Department of Aerospace Engineering. It provides guidance in planning and assists in maintaining the effectiveness of the education program. Its functions include:

- Reviewing of curriculum and courses, the development of recommendations for revisions.
- Assisting in the formulation, structuring and promotion of future development programs
- Assisting in the determination of new technology areas in which research activities should be initiated.
- Assisting the Department in its efforts to communicate with industry, prospective students and the general public

Members of the Advisory Board are drawn from Aerospace organizations outside the university and university officials. The external members include senior engineers from aerospace companies, government laboratories, and federal agencies.