Parks College of Engineering, Aviation and Technology
www.slu.edu/parks

LEADERSHIP
Michelle Sabick, Ph.D.
Dean

DESCRIPTION
Parks College of Engineering, Aviation and Technology prepares students for careers in engineering, aviation, physics and related fields. Satisfying this mission demands excellence in academic programs that integrate the education of the whole person, in the liberal and Jesuit traditions, with classroom and laboratory experiences in the major fields of study. A Parks College education provides opportunities for students to develop intellectually, stay abreast of changing technology, and to prepare for a lifetime of learning.

Programs graduate technically proficient and socially responsible engineering and aviation innovators. Faculty prepare students to be practitioners, leaders and thinkers ... ready to change the world.

ACCREDITATION
The Aerospace Engineering, Biomedical Engineering Civil Engineering, Computer Engineering, Electrical Engineering, Engineering Physics and Mechanical Engineering curricula are accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 – telephone: (410) 347-7700. The Aeronautics curricula with concentrations in Flight Science and Aviation Management are accredited by the Aviation Accreditation Board International (AABI) 3410 Skyway Drive, Auburn, AL USA 36830. The Flight Science concentration prepares students for careers as professional pilots, while the Aviation Management concentration prepares students with specialized knowledge of the aviation industry and a strong foundation in business administration.

UNDERGRADUATE DEGREES OFFERED
Parks College undergraduate programs offer Bachelor of Science degrees with majors in the following areas.

Majors Available
+ Aeronautics
  + Aviation Management
  + Flight Science
+ Aerospace Engineering
+ Biomedical Engineering
+ Civil Engineering
+ Computer Engineering
+ Electrical Engineering
+ Bioelectronics
+ Engineering Physics
+ Mechanical Engineering
+ Physics

Minors Available
+ Air Traffic Control
+ Aerospace Engineering (Parks College, Math, Computer Science, & Physics students only)
+ Biomedical Engineering
+ Flight Science
+ Mechanical Engineering (Parks College, Math, Computer Science, & Physics students only)
+ Physics

ACCELERATED MASTER’S PROGRAM
The Accelerated BS-MS Program in Engineering is a discrete accelerated program that allows high achieving students to complete both B.S. and M.S. degrees in a total of 5 years. Six credits of qualifying coursework can be used to satisfy both the undergraduate and graduate degree requirements. The B.S. degree is in the student’s undergraduate major (aerospace, biomedical, civil, computer, electrical, engineering physics or mechanical engineering), and the M.S. degree is in engineering in the student’s home department. The master’s degree provides additional technical depth and specialization that can lead to expanded career opportunities and responsibilities, as well as preparation for doctoral (Ph.D.) studies.

Undergraduate students may apply to the program in their junior year. Students must apply for admission to the Accelerated B.S.-M.S. program through their home department. Departments will review applications and make recommendations to the Parks College Director of Graduate Programs who will make the final admission decisions.

Program Requirements
The bachelor’s-master’s option requires completion of the standard requirements for a M.S. degree in addition to completion of the standard
requirements of a B.S. degree. The M.S. degree requires 30 credits of coursework, of which up to 9 credits may be research credit. Up to 9 credits may be coursework at the 4000 level; the remaining coursework must be at the 5000 level or above. For course only option, 30 credits of coursework is required. Specific programs of study for each student are developed under the guidance of a faculty mentor. Additional details can be found in the Graduate Catalog.

**POLICIES**

**Math for Entering Students**
Applicants to the engineering or physics programs are encouraged to take mathematics with a focus on trigonometry, such as Pre-Calculus or Analytical Geometry, prior to or during their senior year of secondary school. Students should be prepared to take Calculus I in the first semester of college. Students not prepared to take Calculus I may need to take Pre-Calculus the first semester and Calculus I the second semester, followed by Calculus II and Engineering Physics I during the summer, in order to graduate in four years.

Parks College utilizes the Math-Index to place students in the appropriate mathematics course. The Math-Index is an equation that includes a student’s ACT and/or SAT test scores, high school GPA, and high school math work to determine the appropriate placement. Additional math assessments may be required of beginning and transfer students who have not completed a college-level transferable mathematics course before coming to Parks College. Math assessments do not result in credit being awarded.

Any student intending to major in engineering who is admitted or starts with a math course lower than Pre-Calculus will be considered a Parks College Deciding student. These students must successfully complete Calculus I, demonstrated by receiving a C- or higher, before declaring an engineering major.

**College Level Examination Program**
Parks College accepts successfully completed CLEP results for credit. These, however, must be Subject Examinations. The College does not recognize the General CLEP for credit purposes.

Credit will be granted for CLEP under the following conditions:
+ A maximum of thirty credits can be earned through CLEP.
+ The score on each test must equal or exceed the 50th percentile on the national college sophomore norm.
+ Credit will be awarded in Subject Examinations when approved by the department offering comparable courses. This credit will be awarded on the basis of the number of credits in the pertinent courses.
+ Transfer students please note: Acceptance of CLEP Examinations for advanced standing by another college or university does not automatically ensure the transfer of this credit to Parks College. Recording of advanced standing for CLEP courses on the Academic Record is contingent upon the College’s receiving the Educational Testing Service results of all CLEP examinations for which the student is seeking advanced standing.
+ Full-time students may take external examinations for credit, including required departmental CLEP supplementary examinations, within one calendar year of initial registration at the University.

**Special Registration Procedures**
Some special registration procedures apply to students enrolled in Parks College.

**Pass/No Pass Option**
The maximum number of credits that may be taken on a Pass/No Pass basis is eighteen (18), but not more than one course is permitted during any one semester.

These eighteen (18) credits may be taken under the following options:
+ Any credits above the number required for graduation.
+ Any credits within the number required for graduation which are no longer specified due to the results of testing out of courses and/or advanced placement.
+ Any credits within the area of concentration which are not required by the controlling department and for which the student has received the approval of the academic advisor.

Pass/No Pass credits are not counted towards fulfilling degree requirements. The student must register as a Pass/No Pass member of the class. This status becomes permanent at the time of registration. The student is responsible for seeing that the above conditions are met.

**Audit**
A student may audit a course offered at Parks College with the following reservations:
1. The student must have approval of the instructor and department chair to sit in that particular class. A course taken for credit may be changed to an audit status until the last day to receive a grade of “W”.

2. The student is eligible to take tests if he or she desires; however, students will not be graded.

3. No grade or credit can be earned by auditing a course; an “AU” mark is entered instead of a letter grade, and the course does not count toward fulfilling degree requirements.

4. An exemption examination cannot be taken for an audited course.

Registration at Another Educational Institution
Classified students at Parks may not register for courses at other educational institutions without prior written approval of the Dean of Parks College.

Flight Instruction at Other Institutions
Once a student has enrolled at Parks College, all subsequent flight instruction must be completed in residence at the College. Flight instruction outside of the College’s FAA-approved pilot instruction curricula is not permitted without prior written approval from the Chair of the department (whether currently enrolled or not). Students who receive flight instruction outside the approved curricula without prior approval are subject to dismissal from the program.

Flight fees will be charged in addition to the regular tuition. Please contact the Aviation Science Department for the current rates.

Students with prior flight experience/certification will be evaluated for proficiency at the corresponding flight certification level. Based on the results of such evaluation, the Chief Instructor will recommend either some remedial training or continuation to the next level of training. Ground school courses completed at a Part 141 flight school may be transferable; those completed at a Part 61 flight school may not be transferable. Early consultation with the department chair and/or the Chief Instructor is strongly recommended.

TSA Requirements
The Transportation Security Administration (TSA) requires any individual applying for flight training to provide proof of citizenship prior to beginning the training. New student pilots will be unable to begin flight training until the proof of citizenship requirement is met. Pilots typically provide 1) the individual’s valid, unexpired U.S. passport or 2) the individual’s original or government-issued certified U.S. birth certificate, together with a government-issued picture identification of the individual. Other TSA-specified documents may be accepted. Non-U.S. citizens must receive TSA approval prior to beginning any flight training. Please contact the Flight Training Director’s office for additional information.

Attendance
As a policy, undergraduate students are expected to regularly attend all classes, laboratory sessions and examinations. The implementation of this policy is left to the discretion of the individual instructor with the following exception: no absences are permitted in any course that is required for the Federal Aviation Administration (FAA) regulated pilot certification courses. FAA regulations specify the number of credits required in the approved programs. Students should contact the academic departments for details of these regulations.

If any absences occur, it is the student’s responsibility to make up the missed work. Since the student is expected to regularly attend classes, the instructor is not obligated in any way to provide make-up examinations or additional help on material covered when a student is absent.

When, in the judgment of the instructor, a student has accrued an excessive number of absences, the instructor may report this as an early warning notification to the student and his/her academic advisor. At the discretion of the instructor, a grade of “F” (failure in course) may be given.

When a student is absent because of an authorized student activity, the instructor may excuse the absence. Any scholastic difficulties resulting from the absence, as well as any assignments and examinations, remain the student’s responsibility.

Admission Requirements
Freshman
All applications are thoroughly and carefully reviewed. Solid academic performance in college preparatory course work is a primary criterion in reviewing a freshman applicant’s file. College admission test scores (ACT or SAT) are used as an additional indicator of the student’s ability to meet the University’s academic requirements and to qualify the student for certain University scholarship programs.

To be considered for admission to any Saint Louis
University undergraduate program, the applicant must be approaching graduation from an accredited high school or have an acceptable score on the General Education Development (GED) test.

**Transfer**
Applicants must be a graduate of an accredited high school or have an acceptable score on the GED. An official high school transcript and official test scores are required only of those students who have attempted fewer than 24 transferable semester credits (or 30 quarter credits) of college credit. Those having completed 24 credits or more of college credit need only submit a transcript from previously attended college(s). In reviewing a transfer applicant’s file, the office of admission holistically examines the student’s academic performance in college-level coursework as an indicator of the student’s ability to meet the academic rigors of Saint Louis University.

**SPECIAL ADMISSION REQUIREMENTS**
Admission requirements to Parks College of Engineering, Aviation and Technology degree programs are based on a combination of secondary school grades, college admission test scores, co-curricular activities and attempted college coursework, as well as other indicators of the applicant’s ability, career focus and character. This process respects the non-discrimination policy of the University and is designed to select a qualified, competent and diverse student body with high standards of scholarship and character, consistent with the mission of the University.

**Admission Requirements**
In addition to the general admission and matriculation requirements of the University, Parks College engineering programs have the following additional requirements:

+ GPA: Minimum cumulative 3.00 high school GPA for freshmen applicants and 2.70 college GPA for transfer applicants.
+ ACT/SAT: ACT composite score of 24 or higher, or SAT composite score of 1160 or higher. ACT sub scores minimums of 22 in English, 24 in Mathematics, 22 in Reading Comprehension and 22 in Scientific Reasoning, or SAT Math sub score of 620.
+ Coursework: Fifteen total units of high school work are required: three or four units of English; four or more units of mathematics including algebra I and II, geometry and precalculus (Algebra II with Trigonometry is not sufficient). Students should be prepared to start the first semester freshmen year in Calculus I or higher; three or four units of science including general science, introduction to physical science, earth science, biology, physics or chemistry; two or three units of social sciences including history, psychology or sociology; and three units of electives.

**Scholarships and Financial Aid**
There are two principal ways to help finance a Saint Louis University education:

+ Scholarships: awarded based on academic achievement, service, leadership and financial need.
+ Financial Aid: provided in the form of grants and loans, some of which require repayment.

For priority consideration for merit-based scholarships, applicants should apply for admission by Dec. 1 and complete a Free Application for Federal Student Aid (FAFSA) by March 1.

For information on other scholarships and financial aid, visit the student financial services office online at finaid.slu.edu.

**ACADEMIC CATEGORIES**

**Non-Degree**
Anyone enrolled in Parks College who is not pursuing a program of study designed to obtain a degree from the college or university but who enrolls in one or more classes will be considered a non-degree student. Non-degree students who subsequently decide to pursue a degree must complete the entire process of applying for admission and must be admitted under the usual guidelines and procedures.

**Students in Good Academic Standing**
Students with a cumulative grade point average of 2.00 or higher are classified as students in good standing. Such students are classified as part-time if enrolled for less than twelve credits, full-time if enrolled for between twelve and eighteen credit credits, and full-time on overload if enrolled for more than eighteen credits.

**Students on Supervisory Status**
Minimum satisfactory scholastic achievement at Parks College is represented by a 2.00 cumulative grade point average (a C average). Anyone whose current or term grade point average is below 2.00
and whose cumulative grade point average is above a 2.00 will be considered on supervisory status during the next term in attendance at Parks College. Such students must see their academic advisor prior to the third day of class of next term of enrollment. Supervisory conditions include:

+ Student will not hold office in any student organization during the period of supervisory.
+ Student will be restricted to no more than 15 credits. The academic advisor may grant exceptions to these rules.
+ After receiving mid-term grades, the student must consult with his/her academic advisor as to his/her academic performance. If the student fails to do so, a registration hold will be placed on the academic record.

**Students on Contract Status**

Students whose overall grade point average is below 2.0 will be considered on contract status (probation) during the next term in attendance at Parks College. Such students must see their academic advisor prior to the third day of class of next term of enrollment. Contract conditions include:

+ Student may not hold office in any student organization during the period of probation.
+ Student will ordinarily be restricted to no more than 15 credits.
+ After receiving their mid-term grades, student must consult with their academic advisor as to their academic performance. If the student fails to do so, a registration hold will be placed on their academic record.
+ Student will be required to sign a contract stating that he or she will decrease the credit point deficiency by a fixed amount (to be determined by Parks College) and acknowledging that failure to satisfy this contract can result in dismissal from Parks College. Parks College may grant exceptions to these rules.

The pre-registration of students on supervisory and contract status will be cancelled if the student fails to see their academic advisor prior to the fifth day of class of next term of enrollment. Students who have not registered and attended classes within the first three days of the semester may not be allowed to enroll. A registration hold will be placed on their academic record.

**Dismissed Students**

Parks College enforces the University’s policy on academic dismissal. A student may be dismissed if he or she fails to reach a 2.0 cumulative GPA within two semesters subsequent to the assignment of probation status or reaches a grade point deficiency of more than 15 points. Any student on contract status who does not satisfy the contract he or she signed with Parks College may be dismissed. In addition, any student who fails a course three times can be dismissed from the college.

**Appeal Options for Dismissed Students**

A dismissed student may attempt to again attend Parks College by appealing to the Dean. Information regarding this appeal may be obtained from the Dean’s office.

**Parks College Core Curriculum**

In addition to general requirements specified by the University, all students in degree programs leading to Bachelor of Science degrees must satisfy the Parks College Core Curriculum requirements and additional requirements specified by the individual academic programs.

Parks College of Engineering, Aviation and Technology has established educational objectives for students graduating from Bachelor of Science degree programs. Some objectives are specific and unique to degree programs, while others are broader in scope and may include students and instruction from outside of the degree program and college. The Parks College Core Curriculum describes the educational experiences that the faculty and administration of the college have identified as being “essential” for all Parks College students, and it describes the methods by which selected academic objectives may be accomplished.

**Notice to Students**

Individual degree programs may require specific courses in order to satisfy these requirements. It is recommended that students consult their academic advisor, department chairperson or program director for guidance in choosing core curriculum courses.

**Professional Orientation (One total credit)**

Designed for incoming freshmen, this course provides an orientation to careers in the intended field of study and introduces resources available to students from the department, college and University.

**Jesuit Tradition (12 total credits)**

This portion of the core curriculum is met by taking
a three credit-hour course in theology, a three credit-hour course in philosophy or ethics, and an additional six credit hours in humanistic values which should be chosen from philosophy; theology; the social and behavioral sciences including anthropology, communications, economics, education, political science, psychology, public health, public policy studies, sociology and social work; or the humanities including fine arts, literature, history and foreign language.

**Knowledge (16 total credits)**

This portion of the core curriculum is met by taking a four credit-hour science course with laboratory experience, a three credit-hour mathematics course and additional six credit hours in science or mathematics. Science courses may be selected from astronomy, biology, chemistry, engineering science, geology, meteorology and physics.

**Communication Skills (Three credits)**

A three credit-hour written communication course.

**Cultural Diversity (Three credits)**

Cultural diversity courses are chosen from the list of courses provided by the College of Arts and Sciences. You may also satisfy the cultural diversity requirement with an academic semester of study at an institution where the culture is significantly different from your own; however, the credit hours will need to be replaced with an additional humanistic values course. You should always consult with your department chair prior to the semester of study at another institution.

**Capstone Experience (Three credits)**

A senior-level course or sequence of courses providing opportunities for you to use your acquired and accumulated knowledge on a problem, or in a setting, that is representative of those found in your future profession.

**DOUBLE MAJOR OPTIONS**

A student pursuing two majors from two different colleges should satisfy the core requirements of both colleges.

**Continuation Standards**

Students must maintain a minimum 2.00 GPA.
AEROSPACE & MECHANICAL ENGINEERING

LEADERSHIP
Michael Swartwout, Ph.D.
Department Chair

Faculty
Theodosios Alexander, Sc.D
Richard M. Andres, Ph.D., P.E. (Emeritus)
Patricia A. Benoy, Ph.D. (Emeritus)
Lawrence G. Boyer, M.S.
Sridhar Condoor, Ph.D.
John A. George, Ph.D. (Emeritus)
Jenna Gorlewicz, Ph.D.
Srikanth Gururajan, Ph.D.
Sanjay Jayaram, Ph.D.
Swaminathan Karunamoorthy, Sc.D (Emeritus)
Raymond LeBeau, Ph.D.
Chi Hou Lei, Ph.D.
Jianfeng (Jeff) Ma, Ph.D.
Mark W. McQuilling, Ph.D.
Krishnaswamy Ravindra, Ph.D., P.E.
Michael Swartwout, Ph.D.

BACHELOR OF SCIENCE IN AEROSPACE ENGINEERING

The undergraduate aerospace engineering program is accredited by the Engineering Accreditation Commission of ABET (http://www.abet.org).

Program Educational Objectives
The undergraduate program is designed to meet the following specific objectives in order to fulfill the departmental and institutional missions.

- To practice the principles of engineering in aerospace or allied organizations
- To pursue further learning in aerospace engineering or in allied disciplines
- To function as effective engineers with professional knowledge, skills and values

Student Outcomes
Graduates of the aerospace engineering program at Saint Louis University will demonstrate:

a) an ability to apply knowledge of mathematics, science, and engineering;
b) an ability to design and conduct experiments, as well as to analyze and interpret data;
c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
d) an ability to function on multi-disciplinary teams;
e) an ability to identify, formulate, and solve engineering problems;
f) an understanding of professional and ethical responsibility;
g) an ability to communicate effectively;
h) the broad education necessary to understand the impact of engineering solutions in a global and societal context;
i) a recognition of the need for, and an ability to engage in life-long learning;
j) a knowledge of contemporary issues;
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Program Highlights
The aerospace engineering curriculum provides hands-on experiences that complement theoretical knowledge. Faculty members incorporate innovative engineering experiences in the classroom that shape the student’s mindset in order to become thoughtful leaders and change agents in society. Fluids, thermal, material, structural testing, space systems laboratory equipment and wind tunnels provide an excellent opportunity to integrate theory with real-world applications. State-of-the-art computer laboratories along with advanced software such as CREO, MATHCAD, MATLAB, STK, SC/Tetra CFD, CES Material Selector and Abaqus are available for design, modeling, simulation and analysis. Additionally, students have several extracurricular opportunities to participate in national and international competitions and activities organized by AIAA, SAE, NASA and AFOSR and are involved in the activities of student chapters of AIAA, SAE, SWE and SLU Robotics. Innovative programs like Weekly Innovation Challenge, Tinker Camp, Speakers Pioneering Innovation, Creativity and Entrepreneurship (SPICE), and iScholars help students acquire leadership skills and business acumen.

All students in the aerospace engineering program are exposed to entrepreneurship and the entrepreneurial mindset through the curriculum and extracurricular opportunities.
Additional program highlights include:
+ Aerospace engineering students are given a well-rounded education and are taught not just technical skills but how to be innovative engineers and entrepreneurs.
+ Undergraduate students have an opportunity to participate in research with faculty members in a range of areas from space systems to computational fluid dynamics.
+ Aerospace engineering students have easy access to many state-of-the-art labs and research facilities, including the fluid systems lab that holds one supersonic wind tunnel and two subsonic wind tunnels.

Curriculum Overview
Students of the aerospace engineering program gain a solid foundation of coursework in fundamental engineering sciences before progressing towards traditional aerospace engineering courses. The program offers technical electives in broader areas of aerospace engineering to provide opportunities for students to gain greater depth and understanding. These engineering fundamentals and aerospace topics integrate into a sequence of two capstone courses that provide greater depth in design.

Fieldwork and Research Opportunities
Other benefits of the aerospace engineering program include summer internships and cooperative education programs available with industry in the St. Louis area as well as nationwide.

Students have the opportunity to get hands-on, real-world experience in the Space Systems Research Lab as early as the first week of classes. In this lab students will design, construct and prepare cube satellites for launch.

Aerospace engineering majors also participate in national and international competitions and activities organized by the American Institute of Aeronautics and Astronautics (AIAA), SAE International, NASA and RoboGames. Students can also get involved with student chapters of AIAA, SAE, National Society of Black Engineers, and the Society of Women Engineers.

Funded undergraduate and graduate research opportunities are available with faculty members of the department. Funded research grants ranging from private industries to federal government research laboratories are available for qualified students.

Careers
Corporations and government agencies where successful Parks alumni can be found include:
+ Boeing
+ General Dynamics
+ General Electric
+ Hughes
+ Lockheed Martin
+ NASA, U.S. Air Force, Navy and Army research centers
+ Northrop
+ Pratt-Whitney
+ Raytheon
+ SpaceX

Program Requirements

Basic Engineering (7 credits)
CSCI 1060 Scientific Programming 3
ECE 2001 Electrical & Computer Engineering 3
ECE 2002 Electrical & Computer Engineering Lab 1

Engineering Science Courses (24 credits)
ESCI 2100 Statics 3
ESCI 2150 Dynamics 3
ESCI 2300 Thermodynamics 3
ESCI 3100 Mechanics of Solids 3
ESCI 3101 Mechanics of Solids Lab 1
ESCI 3110 Linear Vibrations 3
ESCI 3200 Fluid Dynamics 3
ESCI 3201 Fluid Dynamics Lab 1
ESCI 3410 Analysis Control Linear Systems 3
MENG 2011 Engineering Shop Practice 1

Aerospace Engineering Courses (39 credits)
AENG 1001 Intro to Aerospace/Mechanical Eng 1
AENG 1002 Computer Aided Engineering Des 1
AENG 2000 Intro to Aero & Astro 3
AENG 3000 Performance 3
AENG 3100 Computer Aided Engineering 3
AENG 3150 Astrodynamics 3
AENG 3210 Gas Dynamics 3
AENG 3220 Aerodynamics 3
AENG 4004 Design I & Lab 3
AENG 4014 Design II & Lab 3
AENG 4110 Flight Vehicle Structures 3
AENG 4111 Aerospace Lab 1
AENG 4210 Propulsion 3
AENG 4400 Stability & Control 3
MENG 4300 Heat Transfer 3

Technical Electives (6 credits)
Choose 6 credits from an approved AE/ME list each semester.

Technical electives provide an opportunity to expand the horizon of each student’s program major or in areas related to program major. Students are encouraged to take courses at 4000 level in the area of program major or a 3000 level or above in allied disciplines. Allied disciplines include courses in engineering other than student’s major, Mathematics – MATH, Computer
Science – CSCI, Management – MGT, Pre-Law – PLS, Physics – PHYS, Chemistry – CHEM and Biology – BIOL. The student may also do a project or research independent study with a faculty member and it is considered as equivalent to technical elective. The courses or independent study in these areas should be beyond the required courses within the curriculum.

**Basic Science & Mathematics (30 credits)**

- CHEM 1070 Engineering Chemistry I Lecture 3
- CHEM 1075 Engineering Chemistry I Lab 1
- PHYS 1610 Engineering Physics I Lecture 3
- PHYS 1620 Engineering Physics I Lab 1
- PHYS 1630 Engineering Physics II Lecture 3
- PHYS 1640 Engineering Physics II Lab 1
- MATH 1510 Calculus I 4
- MATH 1520 Calculus II 4
- MATH 2530 Calculus III 4
- MATH 3550 Differential Equations 3
- MATH 3270 Advanced Math for Engineers 3

**Math/Science Elective (3 credits)**

Choose one 3-credit course from the AE/ME Department approved list.

**Written and Oral Communication (3 credits)**

- ENGL1920 Advanced Writing for Professionals 3

**Liberal Arts (15 credits)**

- THEO 1000 Theological Foundations 3
- PHIL 3400 Engineering Ethics 3
- Humanistic Values Elective 6
- Cultural Diversity 3

Cultural Diversity elective courses must be selected from an approved Arts & Sciences list. See the description of the Parks College core for more information.

Humanistic Values courses shall be chosen from: Humanities or Social & Behavioral Sciences.

**Humanities courses include**

- Fine Arts (excludes applied, studio, and performance courses), Literature (ENGL 2000-2600, 3000-3950, 4100-4790), History, American Studies and Foreign Languages (excludes English or native language), Philosophy or Theology.

**Social & Behavioral Sciences courses include**


**TOTAL CREDITS: 127**

**Continuation Standards**

Students must maintain a minimum 2.00 GPA.

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**BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING**

The undergraduate mechanical engineering program is accredited by the Engineering Accreditation Commission of ABET (http://www.abet.org).

**Program Educational Objectives**

The undergraduate program is designed to meet the following specific objectives in order to fulfill the departmental and institutional missions.

- To practice the principles of engineering in mechanical or allied organizations
- To pursue further learning in mechanical engineering or in allied disciplines
- To function as effective engineers with professional knowledge, skills, and values

**Student Outcomes**

a. an ability to apply knowledge of mathematics, science, and engineering;
b. an ability to design and conduct experiments, as well as to analyze and interpret data;
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
d. an ability to function on multi-disciplinary teams;
e. an ability to identify, formulate, and solve engineering problems;
f. an understanding of professional and ethical responsibility;
g. an ability to communicate effectively;
h. the broad education necessary to understand the impact of engineering solutions in a global and societal context;
i. a recognition of the need for, and an ability to engage in life-long learning;
j. a knowledge of contemporary issues;
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**Program Highlights**

The mechanical engineering curriculum provides hands-on experiences that complement theoretical knowledge. Faculty members incorporate innovative engineering experiences in the
classroom that shape the mindset, so students become thought leaders and change agents in the society. Working with fluids, thermal, material, structural testing, mechatronics and robotics equipment provide an excellent opportunity to integrate theory with real-world applications. Students learn computer aided manufacturing methods using a number of rapid prototype machines along with a high-speed machining center. State-of-the-art computer laboratories along with advanced software such as CREO, MATHCAD, MATLAB, STK, SC/Tetra CFD, CES Material Selector, and Abaqus are available for design, modeling, simulation and analysis.

Additionally, students have several extracurricular opportunities to participate in national and international competitions and activities organized by ASME, SAE, NASA and RoboGames and are involved in the activities of student chapters of ASME, SAE, SWE and SLU Robotics. Innovative programs like Weekly Innovation Challenge, Tinker Camp, Speakers Pioneering Innovation, Creativity, and Entrepreneurship (SPICE) and iScholars help student acquire leadership skills and business acumen.

All students in the mechanical engineering program are exposed to entrepreneurship and the entrepreneurial mindset through the curriculum and extracurricular opportunities.

Additional program highlights include:

+ Mechanical engineering students are given a well-rounded education and taught not just technical skills but how to be innovative engineers and entrepreneurs in their fields.
+ Students have tremendous opportunities to participate in hands-on activities and networking events with industry professionals through a range extra curricular clubs and activities, including the American Society of Mechanical Engineers, the Parks Racing Club, and the Society of Women Engineers.
+ Students have a unique opportunity to work directly alongside faculty members on research projects.

Curriculum Overview

Students of the mechanical engineering program at Parks College will gain a solid foundation in the fundamental engineering sciences before progressing towards traditional mechanical engineering courses. The program offers technical electives in broader areas of structures, thermal fluids, and design engineering to provide opportunities for students to gain greater depth of understanding.

These engineering fundamentals and mechanical topics are then integrated into a sequence of two capstone design courses during senior year that provide greater depth in design. Students will learn the importance of design decisions not only on product design but on society as a whole. Well-equipped laboratory facilities emphasize measurement techniques and experimental methods that allow the student to verify the theory learned in the classroom.

The curriculum is designed to prepare students for professional careers in several fields of mechanical engineering involving product development and manufacturing. The curriculum also provides excellent preparation for graduate studies.

Fieldwork and Research Opportunities

Benefits of the mechanical engineering program also include several internship and career opportunities. Summer internships and cooperative education programs are available with industry in the St. Louis region as well as nationwide.

Funded undergraduate and graduate research opportunities are available with faculty members of the department. Funded research grants ranging from private industries to federal government research laboratories are available for qualified students.

Careers

Industry and government agencies have long recognized the quality of mechanical engineering graduates from Saint Louis University's Parks College. Successful alumni have found employment at corporations and government agencies such as:

+ Boeing
+ General Dynamics
+ General Electric
+ NASA
+ Nooter/Eriksen
+ Textron Systems
+ SpaceX

Program Requirements

| Basic Engineering (7 credits) | CSCI 1060 Scientific Programming | 3 |
| Engineering Science Courses (24 credits) | ECE 2001 Electrical & Computer Engineering | 3 |
| | ECE 2002 Electrical & Computer Engineering Lab | 1 |
| | ESCI 2100 Statics | 3 |
Mechanical Engineering Courses (36 credits)
MENG 1001 Intro to Aerospace/Mechanical Eng 1
MENG 1002 Computer Aided Engineering Des 1
MENG 2000 Foundation to Engineering Design 1
MENG 2300 Applied Thermodynamics 3
MENG 2600 Manufacturing Process/Lab 3
MENG 3001 Mechanical Engineering Lab 1
MENG 3010 Machine Design 3
AENG 3100 Computer Aided Engineering 3
MENG 3430 Measurements 3
MENG 3510 Material Science 3
MENG 4004 Design I & Lab 3
MENG 4014 Design II & Lab 3
MENG 4300 Heat Transfer 3
MENG 4450 Principles of Mechatronics 3

Technical Electives (6 credits)
Choose 6 credits from an approved AE/ME list each semester.

Technical electives provide an opportunity to expand the horizon of each student’s program major or in areas related to program major. Students are encouraged to take courses at 4000 level in the area of program major or a 3000 level or above in allied disciplines. Allied disciplines include courses in engineering other than student’s major, Mathematics – MATH, Computer Science – CSCI, Management – MGT, Pre-Law – PLS, Physics – PHYS, Chemistry – CHEM and Biology – BIOL. The student may also do a project or research independent study with a faculty member and it is considered as equivalent to technical elective. The courses or independent study in these areas should be beyond the required courses within the curriculum.

Basic Science & Mathematics (30 credits)
CHEM 1070 Engineering Chemistry I Lecture 3
CHEM 1075 Engineering Chemistry I Lab 1
PHYS 1610 Engineering Physics I Lecture 3
PHYS 1620 Engineering Physics I Lab 1
PHYS 1630 Engineering Physics II Lecture 3
PHYS 1640 Engineering Physics II Lab 1
MATH 1510 Calculus I 4
MATH 1520 Calculus II 4
MATH 2530 Calculus III 4
MATH 3550 Differential Equations 3
MATH 3270 Advanced Math for Engineers 3

Math/Science Elective (3 credits)
Choose one 3-credit course from the AE/ME Department approved list.

Written and Oral Communication (3 credits)
ENGL1920 Advanced Writing for Professionals 3

Liberal Arts (15 credits)
THEO 1000 Theological Foundations 3
PHIL 3400 Engineering Ethics 3
Humanistic Values Elective 6
Cultural Diversity 3

Cultural Diversity elective courses must be selected from an approved Arts & Sciences list. See the description of the Parks College core for more information.

Humanistic Values courses shall be chosen from: Humanities or Social & Behavioral Sciences.

Humanities courses include
Fine Arts (excludes applied, studio, and performance courses), Literature (ENGL 2000-2600, 3000-3950, 4100-4790), History, American Studies and Foreign Languages (excludes English or native language), Philosophy or Theology.

Social & Behavioral Sciences courses include

TOTAL CREDITS: 124

Continuation Standards
Students must maintain a minimum 2.00 GPA.

DOUBLE MAJOR OPTION

Overview
The double major option allows a student, to take additional courses, to complete a bachelor’s degree with both Aerospace and Mechanical Engineering majors. The student must complete the standard requirements for one of these majors (the primary major). In addition, the student must complete an additional 25 credits in the other field (the secondary major). Students pursuing this option are responsible for creating a schedule that allows them to finish all these courses in a timely fashion while meeting all pre- and co-requisite requirements.

Aerospace Engineering Primary, Mechanical Engineering Secondary

Additional Courses Required (25 credits)
MENG 2300 Applied Thermodynamics 3
MENG 2600 Manufacturing Process/Lab 3
MENG 3001 Mechanical Engineering Lab 1
MENG 3010 Machine Design 3  
MENG 3430 Measurements 3  
MENG 3510 Material Science 3  
MENG 4004 Design I & Lab 3  
MENG 4014 Design II & Lab 3  
MENG 4450 Principles of Mechatronics 3

**Mechanical Engineering Primary, Aerospace Engineering Secondary**

**Additional Courses Required (25 credits)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AENG 2000</td>
<td>Intro to Aero &amp; Astro</td>
<td>3</td>
</tr>
<tr>
<td>AENG 3000</td>
<td>Performance</td>
<td>3</td>
</tr>
<tr>
<td>AENG 3150</td>
<td>Astrodynamics</td>
<td>3</td>
</tr>
<tr>
<td>AENG 3210</td>
<td>Gas Dynamics*</td>
<td>3</td>
</tr>
<tr>
<td>AENG 3220</td>
<td>Aerodynamics*</td>
<td>3</td>
</tr>
<tr>
<td>AENG 4004</td>
<td>Design I &amp; Lab</td>
<td>3</td>
</tr>
<tr>
<td>AENG 4110</td>
<td>Flight Vehicle Structures</td>
<td>3</td>
</tr>
<tr>
<td>AENG 4111</td>
<td>Aerospace Lab</td>
<td>1</td>
</tr>
<tr>
<td>AENG 4210</td>
<td>Propulsion</td>
<td>3</td>
</tr>
<tr>
<td>AENG 4400</td>
<td>Stability &amp; Control</td>
<td>3</td>
</tr>
</tbody>
</table>

* Student must take either Gas Dynamics or Aerodynamics to fulfill double major requirements.

**Continuation Standards**

Students must maintain a minimum 2.00 GPA.

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**AEROSPACE ENGINEERING MINOR**

**Overview**

To provide students pursuing a bachelor’s degree in Mathematics, Computer Science, Physics, Electrical and Computer Engineering, Biomedical Engineering, and Civil Engineering programs an opportunity to explore Aerospace Engineering.

To initiate a Minor in Aerospace Engineering, a student should consult with a faculty member in the Aerospace and Mechanical Engineering (AE/ME) department to discuss the minor courses and their prerequisites aligned with the interest of the student. The completion of a Minor in Aerospace Engineering must be certified by the chair of the AE/ME department as part of the graduation check.

**Program Requirements**

The Minor in Aerospace Engineering requires at least 18 credits of coursework that include a course in Introduction to Aeronautics and Astronautics (AENG 2000) and at least five AENG or ESCI courses at the 2000 level or above (beyond the requirements for a major).

**Continuation Standards**

Grades in all MENG/ESCI minor courses must be C or better.

Students must maintain a minimum 2.00 GPA.

---

**MECHANICAL ENGINEERING MINOR**

**Overview**

To provide students pursuing a bachelor’s degree in Mathematics, Computer Science, Physics, Electrical and Computer Engineering, Biomedical Engineering, and Civil Engineering programs an opportunity to explore Mechanical Engineering.

To initiate a Minor in Mechanical Engineering, a student should consult with a faculty member in the Aerospace and Mechanical Engineering department to discuss the minor courses and their prerequisites aligned with the interest of the student. The completion of a Minor in Mechanical Engineering must be certified by the chair of the AE/ME department as part of the graduation check.

**Program Requirements**

The Minor in Mechanical Engineering requires at least 18 credits of coursework that include a course in Foundations to Engineering Design (MENG 2000) and at least five MENG or ESCI courses at the 2000 level or above (beyond the requirements for a major).

**Continuation Standards**

Grades in all MENG/ESCI minor courses must be C or better.

Students must maintain a minimum 2.00 GPA.
AVIATION

LEADERSHIP
Stephen Magoc, M.B.A.
Department Chair

OVERVIEW
The mission of the Department is to actively engage in the fulfillment of the University’s mission so that students are formed as global citizens who are intellectually, technically and ethically prepared to be responsible leaders in the aviation profession and their community.

The aviation science department continually seeks ways to improve and add to the curriculum. Faculty are engaged in building a team-based, learner-centric pedagogy that will prepare students as outstanding team members and global citizens.

To support its instructional efforts, the aviation science department maintains a varied fleet of aircraft, including Diamond Eclipses and Cirrus SR20 aircrafts for primary and instrument training and Piper Arrows for commercial training. The Piper Seminole serves as a multi-engine trainer. Students also take advantage of a repertoire of Frasca flight training devices (fixed simulators) for simulation training. In addition to those simulators on the flight line, there is a state-of-the-art Canadair Regional Jet-700 simulator in which students take their capstone course, conducting flights as if operating a 70-seat airliner. This additional training prepares students for initial training at a regional airline.

The Department of Aviation Science offers a Bachelor of Science in Aeronautics degree program with concentrations in Aviation Management and Flight Science. Aviation Management (AMGT) prepares the graduate to pursue a variety of careers as a non-flying aviation professional. Flight Science (FSCI) is intended for those students who wish to pursue a career as a professional pilot.

The Department of Aviation Science offers a Master of Science and Doctor of Philosophy in Aviation. The Ph.D. program allows for a customized curriculum in which the student works with their Advisory Committee to identify a plan of study that compliments their scholarly and professional goals. Please see the graduate programs catalog for additional information regarding the M.S. and Ph.D. in aviation degrees.

POLICIES

The Center for Aviation Science “Flight Operations Manual (FOM)” outlines policies, procedures and other information pertaining to flight operations for the purpose of ensuring the highest level of safety, efficiency and effectiveness for flight activity. It is the responsibility of each student and employee to operate in accordance with the provisions of this document. Failure to abide by the policies and procedures contained in the Flight Operations Manual may result in disciplinary action including suspension/termination of flight privileges, a failing grade in a flight course, and dismissal from the Flight Science concentration.

Holders of FAA or EASA Certificates: Transferring Credit to the Aviation Management Program
Students may be able to transfer credits from another institution to meet the academic requirements of the Aviation Management program at Parks College of Engineering, Aviation and Technology. Students must complete at least the last 30 credits of study at Saint Louis University. See our transfer credit policy for additional guidelines.

For students holding the Federal Aviation Administration (FAA) Airframe and Powerplant (A&P) certificate, up to 30 credits may be accepted to meet Emphasis Area Elective requirements of the Aviation Management program, provided the student was eligible to earn the A&P certificate by attendance at an accredited collegiate FAA-approved Part 147 Aircraft Maintenance Technician School (AMTS). The student must provide academic transcripts from the accredited college or university and a copy of the permanent A&P certificate to be considered for acceptance of the credit.

For students holding Federal Aviation Administration (FAA) pilot certificates, up to 20 credits may be accepted to meet Emphasis Area Elective requirements of the Aviation Management program, provided the student was eligible to earn the certificates by attendance at an accredited collegiate, FAA-approved Part 141 flight school for credit of the instrument and commercial pilot ratings. The student must provide academic transcripts from the accredited, collegiate flight school and a copy of the permanent certificates to be considered for acceptance of the credit. Individual certificate credit is shown in table 1.

For students holding the European Aviation Safety Authority (EASA) Commercial Multi-Engine Instrument license with ATP theory and Multi-Crew Coordination course, up to 25 credits may be
accepted to meet Emphasis Area Elective requirements of the Aviation Management program, provided the student was eligible to earn the licenses by attendance at a collegiate, EASA-approved flight program. The student must provide academic transcripts and a copy of the permanent licenses to be considered for acceptance of the credit. Individual license credit is shown in table 1.

Other transfer options include credits awarded towards the FAA’s eligibility requirements for the aviation certificates by the American Council on Education (ACE). ACE credits could allow students to transfer up to 30 credits. Please refer to the information below.

**American Council on Education (ACE)**
A student may receive credit for courses evaluated and approved for college credit by the American Council on Education (ACE). Listings of ACE approved courses and credit recommendations are contained in two publications: A Guide to the Evaluation of Educational Experiences in the Armed Forces and The National Guide to Educational Credit for Training Programs. Credits received are subject to the same policies as those of any other transfer credit.

In all cases, previous college coursework and transfer credits will be evaluated on a case by case basis to give students the best opportunity to succeed in their program of choice.

**Table 1 - Aviation related collegiate-level credit transfer options for students in the Aviation Management program.**

<table>
<thead>
<tr>
<th>Issuing Agency Certificate or License</th>
<th>Credits (maximum)</th>
<th>Parks Equivalency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FAA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airframe and Powerplant Mechanic</td>
<td>30</td>
<td>N/A</td>
</tr>
<tr>
<td>Private Pilot</td>
<td>3</td>
<td>FSCI 1150/1550</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrument Rating (FAR141)</td>
<td>3</td>
<td>FSCI 1550/2150</td>
</tr>
<tr>
<td>Commercial Pilot (FAR141)</td>
<td>3</td>
<td>FSCI 2550/3550</td>
</tr>
<tr>
<td>Commercial Additional (FAR141)</td>
<td>1</td>
<td>FSCI 3550</td>
</tr>
<tr>
<td>Certified Flight Instructor or Advanced Ground Instructor</td>
<td>3</td>
<td>FSCI 3700</td>
</tr>
<tr>
<td><strong>EAA/JAA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private Pilot</td>
<td>3</td>
<td>FSCI 1150/1550</td>
</tr>
<tr>
<td>Instrument Rating</td>
<td>3</td>
<td>FSCI 1550/2150</td>
</tr>
<tr>
<td>Commercial Pilot</td>
<td>3</td>
<td>FSCI 2550/3550</td>
</tr>
<tr>
<td>Commercial Additional</td>
<td>1</td>
<td>FSCI 3550</td>
</tr>
<tr>
<td>ATP Theory</td>
<td>12</td>
<td>FSCI 1250/2250/2650 FSCI 1300</td>
</tr>
<tr>
<td>Multi-Crew Coordination</td>
<td>3</td>
<td>ASCI 4010</td>
</tr>
</tbody>
</table>

**Faculty**
Stephen Belt, Ph.D.
Terrance Kelly, Ph.D.
Saul Robinson, M.M.E.
BACHELOR OF SCIENCE IN AERONAUTICS

The Department of Aviation Science is accredited by the Aviation Accreditation Board International (AABI). As such, the department utilizes the AABI Student Learning Outcomes in its continuing assessment process.

The AABI Student Learning Outcomes are:

A. Apply mathematics, science, and applied sciences to aviation related disciplines
B. Analyze and interpret data
C. Work effectively on multi-disciplinary and diverse teams
D. Make professional and ethical decisions
E. Communicate effectively, using both written and oral communication skills
F. Engage in and recognize the need for lifelong learning
G. Assess contemporary issues
H. Use the techniques, skills, and modern technology necessary for professional practice
I. Assess the national and international aviation environment
J. Apply pertinent knowledge in identifying and solving problems
K. Apply knowledge of business sustainability to aviation issues.

Assessment of Program Student Learning Outcomes:

Aviation Management Program Assessment and Student Success (AABI 3.4.2 Compliance)
2017-2018 Aviation Management Annual Assessment Report

Flight Science Program Assessment and Student Success (AABI 3.4.2 Compliance)

Program Highlights

Saint Louis University’s Parks College of Engineering, Aviation and Technology was the first federally certified flight school in the nation, founded by Oliver L. Parks in 1927. Today, Saint Louis University is the only Jesuit university with a flight program, making us a premier institution for flight education. This Jesuit heritage means students learn to make ethical decisions that contribute to their personal and professional goals and allow them to enrich the community in which students live and work.

Students learn to fly in some of the world’s most advanced light aircraft: the Diamond DA-20, Cirrus SR20 with Garmin Perspective, the Piper Arrow with Avidyne Entegra integrated flight deck and the Piper Seminole. Advanced students further their studies of larger aircraft in a state-of-the-art Canadair Regional Jet-200 simulator. Students receive a holistic education that includes foundational and advanced courses in flight science and aviation management rounded out by the traditional core classes and elective courses.

Additional program highlights include:

+ Saint Louis University is the only Jesuit University in the United States to offer aviation science degrees, and students are offered a much more well-rounded curriculum to educate the "whole person."
+ The flight training is conducted out of St. Louis Downtown Airport which is located between Lambert-St. Louis International Airport and Scott Air Force Base, providing aviation students with a complex and dynamic environment to learn to fly in.
+ The aviation science department has been granted a Letter of Authorization from the FAA making graduates eligible for a maximum reduction of 500 hours towards the 1,500 hour requirement for the Airline Transport Pilot Certificate.

Curriculum Overview

The flight portion of the B.S. in flight science curriculum is approved by the Federal Aviation Administration (FAA) under Part 141. Graduates of the program will have earned the following FAA certificates and ratings: private pilot certificate, instrument rating, and commercial pilot certificate with single and multi-engine ratings. Additionally, students enrolled in the flight education minor, with courses offered under FAA Part 61, can earn the certified flight instructor, certified flight instructor instrument and certified flight instructor multi-engine certificates.

Students enrolled in the Flight Science concentration are encouraged to diversify their educational experience and explore areas outside
of their major. The Flight Science concentration requires all students to complete a university minor or grouping of affiliated electives (approved emphasis area). For example, Flight Science students may enroll in a Business Certificate program offered by the Richard A. Chaifetz School of Business.

The Aviation Management concentration prepares the graduate for entry-level positions within the aviation and space industries, and/or government agencies. Career opportunities for graduates include: management and supervisory positions with commercial airlines, the aircraft/aerospace industry, airports and governmental agencies, as well as positions as contract negotiators, budget analyst, project administrators, personnel directors and positions in sales, marketing and advertising.

The goal of the Aviation Management concentration is to not only prepare graduates to manage aviation operations, but also to prepare them as socially responsible leaders who have a strong foundation in technical skills and are equipped with sufficient breath of experience in liberal arts and sciences to make a difference in both their professional and personal lives.

The Aviation Management concentration places a strong emphasis on the safety and business aspects of aviation. From air carrier to manufacturing to airport management, the Aviation Management curriculum includes the necessary coursework and experience to serve the business and safety needs in aviation.

The Aviation Management concentration is offered as a residential concentration (on-campus) as well as a distance concentration (on-line). The concentrations are similar in course content and quality with distance concentration geared toward the working professional.

Reduced Airline Transport Pilot (ATP) Minimums
Saint Louis University has been granted approval to provide a transcript endorsement certifying graduates for a 250-hour or 500-hour reduction towards the ATP Certificate for the Bachelor of Science in aeronautics degree with a major in flight science or aviation management. For students to qualify for this reduction, students must complete 30 credits of approved coursework to be eligible for the 250-hour reduction, or complete 60 credits of approved coursework to be eligible for the 500-hour reduction. To learn more about the FAA approved curriculum, visit aviation.slu.edu.

Distance Education Option – Aviation Management
Students who are unable to attend class in St. Louis may wish to consider the Distance Option for the Aviation Management concentration. In partnership with the Saint Louis University School for Professional Studies (SPS), the Distance Aviation Management concentration offers the same aviation coursework taught by the same faculty as the on-ground concentration. Non-aviation coursework is provided by the School for Professional Studies, a pioneer in distance education here at Saint Louis University.

The Distance Aviation Management concentration maintains the same level of academic rigor and expectations of the on-ground program. The Distance Aviation Management concentration is especially well-suited for military personnel and dependents, including retirees receiving G.I. benefits.

Careers
Benefits of the flight science program also include several internship and career opportunities. The aviation science department provides valuable internship opportunities with Delta Air Lines, Southwest Airlines, Trans States Airlines, JetBlue and other carriers. Other corporate internships are also available. These internships are highly competitive.

The flight science degree prepares graduates to enter the aviation industry as a professional pilot in the airline, corporate and military sectors. After earning their flight instructor certificates, graduates who do not enter a military career track typically seek a flight instructor position to develop their experience for one–three years at which time students are qualified for a position with a regional airline or corporate flight department.

Restricted ATP Rule:
Students who graduate from Saint Louis University, under the Institutional Authority Program, are eligible for a transcript endorsement leading to a restricted ATP certificate with either 1,000 or 1,250 hours of flight experience depending on the number of approved credits completed. Students who graduate from unapproved institutions require 1,500 hours of flight experience prior to ATP certification. This also allows students to qualify for the ATP certification at the age of 21 instead of having to wait until age 23.

Students completing the flight science degree are
eligible to participate in one of the "pipeline" or "pathway" programs that Parks College participates in with the following airlines:

+ Airline Pathway Program (AP3) – ExpressJet Airlines
+ Pilot Pipeline Program – Envoy Air, Inc.
+ Aviation Career Pipeline Interview Program – Republic Airways Holdings
+ Aviators Program - A Professional Pilot Career Pipeline – Trans States Airlines

**Additional Admission Requirements**

**Flight Science Concentration**

Enrollment capacity in the Flight Science program may be limited; therefore, early application is strongly encouraged.

In addition to the general admission and matriculation requirements of the University, applicants to any flight science programs must be able to pass a Federal Aviation Administration class II medical examination. This physical examination is an absolute prerequisite for flight training and should be taken prior to the student’s arrival on campus. For specific information regarding the examination, visit the FAA online at faa.gov/pilots/amelocator. Early application for admission to the flight science program is strongly encouraged as capacity may be limited.

International students will be evaluated for their listening comprehension and spoken ability in addition to meeting regular English requirements. Prior to commencing flight instruction, special training will be required for those students found deficient in this evaluation.

All applications are thoroughly reviewed with the highest degree of individual care and consideration to all credentials that are submitted. To be considered for admission to any Saint Louis University undergraduate program, the applicant must be graduating or have graduated from an accredited high school or have an acceptable score on the General Education Development (GED) test.

**Flight Science Concentration**

**Professional Orientation (3 credits)**

| ASCI 1010 Professional Orientation | 2 |
| UNIV 1010 Enhancing 1st Yr. Success | 1 |

**Jesuit Tradition (12 credits)**

| PHIL 1050 Introduction to Philosophy | 3 |
| PHIL 2050 Ethics | 3 |
| PSY 1010 General Psychology | 3 |
| THEO 1000 Theological Foundations | 3 |

**Knowledge (13 credits)**

| ASCI 1300 Aviation Weather | 3 |
| ITM 2000 Intro to Info Tech | 3 |
| OPM 2070 Introduction to Statistics | 3 |
| PHYS 1350 Aviation Physics I/Lab | 4 |

**Mathematics Sequence (6-7 credits)**

Students should complete one of the two math sequences.

| MATH 1200 College Algebra | 3 |
| MATH 1320 Survey of Calculus | 3 |
| Or | |
| MATH 1400 Pre-Calculus | 3 |
| MATH 1510 Calculus I | 3 |

**Written and Oral Communication (12 credits)**

- CMM 1200 Public Speaking | 3 |
- ENGL 1500 The Process of Composition | 3 |
- ENGL 1900 Adv. Str. Rhetoric and Research | 3 |
- ENGL 2020 or higher | 3 |

**Cultural Diversity (3 credits)**

Cultural Diversity elective courses must be selected from an approved Arts & Sciences list. See the description of the Parks College core for more information

Cultural Diversity Elective | 3 |

**Aviation Science (18 credits)**

| ASCI 1850 Safety Management Systems | 3 |
| ASCI 3100 Air Carrier Operations | 3 |
| ASCI 4050 Human Factors | 3 |
| ASCI 4250 Professional Ethics and Standards | 3 |
| ASCI 4350 Team Resource Management | 3 |
| ASCI 4450 Aviation Law | 3 |

**Flight Science (49 credits)**

Additional flight fees apply to all flight courses—contact the Department for current rates.

| ASCI 2200 Concepts in Aerodynamics | 3 |
| ASCI 3010 Jet Transport Systems I | 3 |
| ASCI 3020 Jet Transport Systems II | 3 |
| ASCI 3062 Turbine Aircraft Transition | 2 |
| ASCI 4012 Jet Flying Techniques I | 3 |
| ASCI 4013 Jet Flying Techniques I Lab | 1 |
| ASCI 4022 Jet Flying Techniques II | 3 |
| ASCI 4023 Jet Flying Techniques II Lab | 1 |
| FSCI 1150 Flight 1 and Lab | 3 |
| FSCI 1250 Basic Flight Foundations | 3 |
| FSCI 1550 Flight 2 and Lab | 3 |
| FSCI 2150 Flight 3 and Lab | 3 |
| FSCI 2250 Instrument Flight Foundations | 3 |
| FSCI 2550 Flight 4 and Lab | 3 |
| FSCI 2650 Navigation Flight Foundations | 3 |
| FSCI 3550 Flight 5 and Lab | 3 |
| FSCI 3700 Principles of Flight Instruction I | 3 |
| FSCI 3750 Flight Instruction Preparation I | 3 |

**Approved Emphasis Area (4 credits)**

Emphasis areas may consist of a minor, certificate program or any other concentrated area of study approved by the Aviation Science Department.

**TOTAL CREDITS: 120-121**

**FAA Certificate or Rating under 14 CFR 141**

Within the Aviation Science program, the following classes provide training toward a Federal Aviation Administration certificate or rating under 14 CFR 141:
FSCI 1150 Flight 1 and Lab
This course provides 31.0 hours in an aircraft and 5.0 hours in an aircraft training device.

FSCI 1550 Flight 2 and Lab
This course provides 47.0 hours in an aircraft and 6.0 hours in an aircraft training device.

FSCI 2150 Flight 3 and Lab
This course provides 41.0 hours in an aircraft and 14.5 hours in an aircraft training device.

FSCI 2550 Flight 4 and Lab
This course provides 42.0 hours in an aircraft and 14.5 hours in an aircraft training device.

FSCI 3550 Flight 5 and Lab
This course provides 40.0 hours in an aircraft and 10.5 hours in an aircraft training device.

FSCI 3750 Principles of Flight Instruction I
This course provides 14.0 hours in an aircraft.

Flight Training Requirements
All flight training must be completed at Saint Louis University. Students with prior flight experience or certification will be evaluated for proficiency at the corresponding flight certification level. Students who do not hold the Private Pilot certificate upon starting the Flight Science concentration or minor are required to take FSCI 1150 Flight 1 and FSCI 1550 Flight 2. Those students who currently hold the Private Pilot certificate are required to take FSCI 1560 Flight 2 Transition.

Global Flight Science Option
A majority of countries across the globe adhere to either Federal Aviation Administration (FAA) or European Aviation Safety Agency (EASA) standards for certification of flight crews. By preparing students to meet both FAA and EASA knowledge requirements, the Global Flight Science Option intends to prepare students for professional flight careers in most countries across the world. Following the freshman year in Madrid, students arrive in St. Louis for the sophomore, junior and senior year. While in St. Louis, students work toward FAA flight ratings including the Private, Instrument and Commercial Multi-Engine pilot. Upon graduation from the Global Flight option in St. Louis, students have the option of returning to Madrid or other global regions for additional transition training leading to international certification.

While in Madrid, students will enroll in ground school coursework and an introduction to European aviation standards and regulations. All coursework is delivered in English while students experience the diversity of a major European metropolitan area. The Global Flight Science option provides the student with a multicultural experience in preparation for careers as globally qualified flight crewmembers.

Aviation Management Concentration (On-Ground)

Professional Orientation (3 credits)
ASCI 1010 Professional Orientation 2
UNIV 1010 Enhancing 1st Yr. Success 1

Jesuit Tradition (12 credits)
PHIL 1050 Introduction to Philosophy 3
PHIL 2050 Ethics 3
PSY 1010 General Psychology 3
THEO 1000 Theological Foundations 3

Knowledge (10 credits)
ASCI 1300 Aviation Weather 3
PHYS 1350 Aviation Physics I/Lab 4
ITM 2000 Intro to Info Tech 3

Mathematics Sequence (6-7 credits)
Students should complete one of the two math sequences.
MATH 1200 College Algebra 3
MATH 1320 Survey of Calculus 3
Or
MATH 1400 Pre-Calculus 3
MATH 1510 Calculus I 4

Written and Oral Communication (12 credits)
CMM 1200 Public Speaking 3
ENGL 1500 The Process of Composition 3
ENGL 1900 Adv. Str. Rhetoric and Research 3
ENGL 2020 or higher 3

Cultural Diversity (3 credits)
Cultural Diversity elective courses must be selected from an approved Arts & Sciences list. See the description of the Parks College core for more information.

Aviation Science (18 credits)
ASCI 1850 Safety Management Systems 3
ASCI 3100 Air Carrier Operations 3
ASCI 4050 Human Factors 3
ASCI 4250 Professional Ethics and Standards 3
ASCI 4350 Team Resource Management 3
ASCI 4450 Aviation Law 3

Aviation Management (42 credits)
ASCI 1510 The Air Transportation System 3
ASCI 2250 Aviation and Airport Security 3
ASCI 2750 Accident Investigation 3
ASCI 3050 Ops and Bus Environment of Aviation 3
ASCI 4650 Economics of Air Transportation 3
ASCI 4800 International Aviation 3
ASCI 4900 Senior Seminar (Capstone) 3
ASCI 4915 Internship with Industry 3
ECON 1900 Principles of Economics 3
ENGL 4000 Business & Professional Writing 3
MGT 3000 Management Theory and Practice 3
MGT 3300 Management of Human Resources 3
OPM 2070 Introduction to Statistics 3
OPM 3050 Introduction to Management Science 3

Approved Emphasis Area (15 credits)
Emphasis areas may consist of a minor, certificate program or any other concentrated area of study approved by the Aviation Science Department.

TOTAL CREDITS: 121-122

Aviation Management Concentration (Online)

Professional Orientatio (3 credits)
ASCI 1010 Professional Orientation 2
PST 1000 Enhancing 1st Yr. Success 1

Jesuit Tradition (12 credits)
PHIL 1050 Introduction to Philosophy 3
PHIL 2050 Ethics 3
PSY 1010 General Psychology 3
THEO 1000 Theological Foundations 3

Knowledge (10 credits)
CIS 1300 Information System & Technology 3
FSCI 1300 Aviation Weather 3
PHYS 1350 Aviation Physics I/Lab 4

Mathematics Sequence (6-7 credits)
Students should complete one of the two math sequences.
MATH 1200 College Algebra 3
MATH 1320 Survey of Calculus 3
Or
MATH 1400 Pre-Calculus 3
MATH 1510 Calculus I 4

Written and Oral Communication (12 credits)
CMM 1200 Public Speaking 3
ENGL 1500 The Process of Composition 3
ENGL 1900 Adv. Str. Rhetoric and Research 3
ENGL 2020 or higher 3

Cultural Diversity (3 credits)
Cultural Diversity elective courses must be selected from an approved Arts & Sciences list. See the description of the Parks College core for more information

Aviation Science (30 credits)
ASCI 1510 The Air Transportation System 3
ASCI 1850 Safety Management Systems 3
ASCI 2250 Aviation and Airport Security 3
ASCI 2750 Accident Investigation 3
ASCI 3050 Ops and Bus Environment of Aviation 3
ASCI 3100 Air Carrier Operations 3
ASCI 4050 Human Factors 3
ASCI 4250 Professional Ethics and Standards 3
FSCI 4450 Aviation Law 3
OSTD 3305 Team Dynamics 3

Aviation Management (30 credits)
ASCI 4800 International Aviation 3
ASCI 4900 Senior Seminar (Capstone) 3
ASCI 4915 Internship with Industry 3
CIS 2850 Principles of Data Analysis 3
ENGL 4000 Business & Professional Writing 3
FSCI 4650 Economics of Air Transportation 3
OSTD 3200 Interpersonal Relations in Org. 3
OSTD 3005 Organizational Foundations 3
PST 1900 Survey of Economics 3
PST 3200 Human Resources in Organizations 3

Approved Emphasis Area (15 credits)
Emphasis areas may consist of a minor, certificate program or any other concentrated area of study approved by the Aviation Science Department.

TOTAL CREDITS: 121-122

Continuation Standards
A student may remain academically eligible to continue coursework in the department’s academic programs by maintaining a minimum GPA of 2.0 or the equivalent of a letter grade of C. Any student receiving a single C-, D, F, or U grade in a course with an ASCI or FSCI prefix that is required for graduation in an Aviation Management or Flight Science major or minor will be required to repeat the course in which the C-, D, F, or U grade was received. If the course is a prerequisite to another course in the Aviation Management or Flight Science program, the student will be required to repeat the course in which the C-, D, F, or U grade was received. The student will not be allowed to progress into the subsequent course until a grade of C is achieved in the prerequisite course.

Students enrolled in the Flight Science concentration are allowed two (2) attempts to earn a grade of C or better in any of the flight courses that are part of the academic program. A student receiving a C-, D, F, or U grade in a repeated course is subject to dismissal from the program.

If a student’s GPA drops below a 2.0, that student will not be eligible for a flight slot the following semester.

An appeal of a grade, progression in the program, or dismissal from the program may be made in accordance with the procedures outlined in the Department of Aviation Science Student Appeal Process, a copy of which can be obtained from the department chairperson or from the Parks College of Engineering, Aviation and Technology Office of the Dean.

Students should be aware that situations such as those described above could jeopardize one’s planned graduation date due to the manner in which courses are scheduled each academic year.

FLIGHT SCIENCE MINOR
Overview
All University majors (including those who have not declared a specific major or are pursuing pre-professional programs such as pre-law and pre-medicine) are eligible to obtain a minor in Flight Science. This minor will enable the students to obtain Private Pilot Certificate, Instrument Rating, Commercial Pilot Certificate, and Multiengine Rating. The following courses are required. Note: additional fees apply to all flight courses—contact the Department for current rates. (Not available via distance)

Program Requirements

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSCI 1150</td>
<td>Flight 1</td>
<td>3</td>
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<tr>
<td>FSCI 1250</td>
<td>Basic Flight Foundations</td>
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<td>Flight 3</td>
<td>3</td>
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<tr>
<td>FSCI 2250</td>
<td>Instrument Flight Foundations</td>
<td>3</td>
</tr>
<tr>
<td>FSCI 2550</td>
<td>Flight 4</td>
<td>3</td>
</tr>
<tr>
<td>FSCI 2650</td>
<td>Navigation Flight Foundations</td>
<td>3</td>
</tr>
<tr>
<td>FSCI 3550</td>
<td>Flight 5</td>
<td>3</td>
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</tbody>
</table>

TOTAL CREDITS: 24

Continuation Standards
A student may remain academically eligible to continue coursework in the department's academic programs by maintaining a minimum GPA of 2.0 or the equivalent of a letter grade of C. Any student receiving a single C-, D, F, or U grade in a course with an ASCI or FSCI prefix that is required for graduation in an Aviation Management or Flight Science major or minor will be required to repeat the course in which the C-, D, F, or U grade was received. If the course is a prerequisite to another course in the Aviation Management or Flight Science program, the student will be required to repeat the course in which the C-, D, F, or U grade was received. The student will not be allowed to progress into the subsequent course until a grade of C is achieved in the prerequisite course.

Students enrolled in the Flight Science minor are allowed two (2) attempts to earn a grade of C or better in any of the flight courses that are part of the academic program. A student receiving a C-, D, F, or U grade in a repeated course is subject to dismissal from the program.

An appeal of a grade, progression in the program, or dismissal from the program may be made in accordance with the procedures outlined in the Department of Aviation Science Student Appeal Process, a copy of which can be obtained from the department chairperson or from the Parks College of Engineering, Aviation and Technology Office of the Dean.

Students should be aware that situations such as those described above could jeopardize one's planned graduation date due to the manner in which courses are scheduled each academic year.

FLIGHT EDUCATION MINOR

Overview

Program Requirements

Continuation Standards

MASTER OF SCIENCE IN AVIATION

Program Highlights
The Master of Science in aviation provides a competitive and rigorous program that prepares graduates for leadership roles within the aviation industry. The program is well-suited for the working professional as 100% of the courses are taught online, with the exception of a 2-credit internship requirement. The coursework provides a strong foundation and prepares students to perform aviation-related up-to-date research, all of which positions the student for a successful career in a wide variety of aviation positions.

Curriculum Overview
The program consists of 32 credits of graduate-level work: a common core and a graduate-level internship experience. All courses are offered online. Each M.S. student prepares a program of study that must be approved by their faculty advisor, the department chair and the associate dean for graduate education and research for Parks College. This program of study is developed within the context of the student's background and career goals, allowing students to customize their graduate program to suit their professional goals.

Fieldwork and Research Opportunities
The expert faculty of Parks College collaborate with graduate students in ground-breaking research in the following areas:

+ Flight control systems
+ Flight education
+ Human factors/physiology
+ Safety
+ Unmanned aerial systems

Careers
Possible career fields for Master of Science
graduates include flight training and education, aviation-related management and aviation safety. After graduating, alumni are qualified for management positions within the aviation industry.

Admission Requirements
Most admitted students meet the following criteria:

- GRE quantitative score greater than 650 (old grading system) or greater than 150 (new grading system)
- Undergraduate GPA of at least 3.0
- A four-year undergraduate degree in aviation or related field of desired graduate program

Application Requirements
- Online application form and fee
- Official transcript(s) of all previous degrees
- Three letters of recommendation (preferably from recent instructors)
- GRE scores
- Curriculum vitae/résumé
- Professional goal statement

Requirements for International Students
- International students whose native language is not English must provide evidence of English language proficiency by submitting their TOEFL or IELTS results. Minimum scores required:
  - TOEFL PBT 550
  - TOEFL IBT 80
  - IELTS 6.5

Application and Assistantship Deadlines
The department is only reviewing applications for the fall semester. To be considered for enrollment in the fall semester, students should submit their application materials by May 31.

Admitted students who want to be considered for an assistantship must submit a separate application for assistantship consideration by March 1.

Review Process
Once all the materials are received and the online application is complete, the application is reviewed by the Parks College Office of Graduate Education and Research before being sent to the aviation department for a recommendation. The final decision is made by Parks’ director of graduate programs.

Admissions decisions are made based on the background and educational experience of students. Applications are reviewed when completed, and decisions are generally made within a few weeks.

Scholarships and Financial Aid
Parks College offers graduate fellowship awards and assistantships each year. Assistantships provide tuition, stipend and health insurance. There are also many opportunities for students to receive funding through external research grants that are managed by individual faculty.

For more information, visit the student financial services office online at finaid.slu.edu.

Program Requirements
The M.S. in Aviation requires a minimum of 32 credits beyond a bachelor’s degree. The M.S. in Aviation is non-thesis, a course only degree.

Non-Course Requirements
Continuation Standards
Students are expected to maintain a cumulative grade point average (GPA) of 3.00; lower GPA may result in probationary status and/or dismissal from the program due to unsatisfactory academic performance.

DOCTOR OF PHILOSOPHY IN AVIATION
Program Highlights
As a Ph.D. student in aviation science, students will complete coursework before scheduling a qualifying exam, which focuses on topics related to the coursework and assesses general preparation for graduate research. Upon successfully passing the qualifying exam, students will develop a dissertation proposal under the supervision of a research mentor. Then students will present and defend the dissertation proposal. After conducting research and writing a dissertation, students will defend the dissertation in a public forum and then privately to the committee.

Curriculum Overview
Students will work with their advisor and Ph.D. committee to determine the specific coursework to complete the program. Those students holding an appropriate Master of Science degree may include a maximum of 27 credits of the associated M.S. degree course credits, but not the thesis or project credits, in the 63 credits required for the Ph.D. Degree.
Fieldwork and Research Opportunities
The expert faculty of Parks College collaborate with graduate students in ground-breaking research in the following areas:
+ Flight control systems
+ Flight education
+ Human factors/physiology
+ Safety
+ Unmanned aerial systems

Careers
Ph.D. graduates are uniquely qualified to conduct aviation-related research in academia, government and industry.

Admission Requirements
Most admitted students meet the following criteria:
GRE quantitative score greater than 650 (old grading system) or greater than 150 (new grading system)
Undergraduate GPA of at least 3.0
A four-year undergraduate degree in aviation or related field of desired graduate program

Application Requirements
+ Online application form and fee
+ Official transcript(s) of all previous degrees
+ Three letters of recommendation (preferably from recent instructors)
+ GRE scores
+ Curriculum vitae/résumé
+ Professional goal statement

Requirements for International Students
+ International students whose native language is not English must provide evidence of English language proficiency by submitting their TOEFL or IELTS results. Minimum scores required:
  + TOEFL PBT 550
  + TOEFL IBT 80
  + IELTS 6.5

Application and Assistantship Deadlines
The department is only reviewing applications for the fall semester. To be considered for enrollment in the fall semester, students should submit their application materials by May 31.
Admitted students who want to be considered for an assistantship must submit a separate application for assistantship consideration by March 1.

Review Process
Once all the materials are received and the online application is complete, the application is reviewed by the Parks College Office of Graduate Education and Research before being sent to the aviation department for a recommendation. The final decision is made by Parks’ director of graduate programs.
Admissions decisions are made based on the background and educational experience of students. Applications are reviewed when completed, and decisions are generally made within a few weeks.

Scholarships and Financial Aid
Parks College offers graduate fellowship awards and assistantships each year. Assistantships provide tuition, stipend and health insurance. There are also many opportunities for students to receive funding through external research grants that are managed by individual faculty.
For more information, visit the student financial services office online at finaid.slu.edu.

Program Requirements
The Doctor of Philosophy in aviation requires a total of 63 credits beyond a bachelor's degree, including:
+ 12 credits of dissertation research
+ At least 12 credits of coursework in research methodologies
+ At least 12 credits in a second discipline complementary to the knowledge of aviation
Students will work with an adviser and Ph.D. committee to determine the specific coursework to complete the Ph.D. in aviation. If students have an applicable master’s degree, 27 credits of that program may count towards the 63 credits necessary, with department approval. No research or project credits will be counted towards the Ph.D.

Non-Course Requirements
Continuation Standards
Students are expected to maintain a cumulative grade point average (GPA) of 3.00; lower GPA may result in probationary status and/or dismissal from the program due to unsatisfactory academic performance.
BIOMEDICAL ENGINEERING

LEADERSHIP
Gary Bledsoe, Ph.D.
Department Chair

Faculty
Natasha Case, Ph.D.
Yan Gai, Ph.D.
Koyal Garg, Ph.D.
Andrew Hall, Ph.D.
Michelle B. Sabick, Ph.D.
Scott Sell, Ph.D.
Silviya P. Zustiak, Ph.D.
Marta Cooperstein, Ph.D.

OVERVIEW
The Department of Biomedical Engineering (BME) offers an undergraduate degree program that combines math, chemistry, and physics, as well as biology and physiology to form a unique engineering discipline. The first two years build a strong foundation of basic sciences and liberal arts, with introductory engineering. In the next two years, courses and labs build on the basic sciences and math to provide a focus of integrative courses in Biomedical Engineering. The BME courses span a range of subspecialties, including biomechanics, biomaterials, biosignals, biomeasurements, and biotransport. Within these courses, topics may address problems in areas like cardiology, orthopedics, neurobiology, biology, or psychology. Students develop research and design skills in courses and laboratories throughout the curriculum, but the senior project provides a culminating experience by focusing on a specific yearlong problem that may be done individually or in teams.

The undergraduate degree program offers considerable flexibility, allowing time for electives within and outside the Department. The curriculum is designed for students whose post-baccalaureate career plans are graduate school, industry, or professional schools. The courses and laboratory experiences provide a broad fundamental preparation for any of the three career paths. At the same time, students can choose advanced courses, senior project, and lab experience to define their specific areas of interest. For students seeking an even broader engineering experience, the Department offers an Interdisciplinary Engineering degree that combines the fundamentals of engineering with a variety of enrichment areas selected by the student in consultation with the faculty mentor.

POLICIES
The Biomedical Engineering curriculum satisfies the Parks College requirements, and includes the flexibility, through electives, to tailor the curriculum for each individual student.

All BME courses with the exception of BME 1000 have prerequisites that require a “C-” or better. The prerequisites for BME courses are available in the Department office. Any waiver of a specified prerequisite for a course must be approved by the BME Faculty member offering that course.

BACHELOR OF SCIENCE IN BIOMEDICAL ENGINEERING
The undergraduate biomedical engineering program is accredited by the Engineering Accreditation Commission of ABET (http://www.abet.org).

Program Educational Objectives
The undergraduate program is designed to meet the following specific objectives in order to fulfill the departmental and institutional missions.

- Graduates will have established themselves as practicing engineers in biomedical engineering and health related positions in industry, government and academia.
- Graduates will have acquired advanced degrees or be engaged in advanced study in biomedical engineering or other fields related to their long term career goals.
- Graduates will attain a major milestone in their career development within the first five to seven years.

Student Outcomes
Graduates of the BME program at Saint Louis University will demonstrate:

a) an ability to apply knowledge of mathematics, science, and engineering;

b) an ability to design and conduct experiments, as well as to analyze and interpret data;

c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical,
health and safety, manufacturability, and sustainability;
d) an ability to function on multi-disciplinary teams;
e) an ability to identify, formulate, and solve engineering problems;
f) an understanding of professional and ethical responsibility;
g) an ability to communicate effectively;
h) the broad education necessary to understand the impact of engineering solutions in a global and societal context;
i) a recognition of the need for, and an ability to engage in life-long learning;
j) a knowledge of contemporary issues;
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;
l) an understanding of biology and physiology, and the capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology;
m) an ability to make measurements on and interpret data from living systems, addressing the problems associated with the interaction between living and non-living materials and systems.

Program Highlights
The biomedical engineering department at Saint Louis University’s Parks College of Engineering, Aviation and Technology originated in 1997 and quickly developed into a strong and successful undergraduate program. The biomedical engineering (BME) undergraduate program prepares students for careers ranging from fundamental engineering research to the application of engineering principles to the solution of biomedical design problems.

The BME degree combines Saint Louis University’s strengths in medicine and life sciences with engineering. Students learn to apply science and engineering principles to biological and medical sciences. Students also discover opportunities for collaborative research in areas such as biomechanics and orthopedics, tissue engineering, kinetics and metabolism, neuroengineering, medical robotics, and medical imaging.

Curriculum Overview
The B.S. degree in biomedical engineering is designed with three tracks to accommodate the different career paths of graduates.

The curriculum leading to the B.S. degree offers considerable flexibility, allowing time for electives within and outside the department. The curriculum is designed for students whose postundergraduate career plans include graduate school, industry or professional schools (medicine, law or business).

The courses and laboratory experiences provide a broad fundamental preparation for any of these career paths. The program is designed with an emphasis on providing a BME focus in all core engineering classes that integrates undergraduate research into the students experience from the very beginning.

Because of the flexibility in our degree, our undergraduates participate in a number of academic programs across campus, including the Medical Scholars Program and the University Honors Program. BME majors can also complete certificates, minors or second majors in a variety of disciplines ranging from the liberal arts or science to business or technology. The department also offers a minor for students interested in developing a focused study within the field of BME.

Fieldwork and Research Opportunities
Many laboratory experiences coincide with courses such as in the basic science and engineering courses. Some lab courses are built around a series of experiences in several different labs throughout campus. This variety gives the student insight and appreciation for the rich diversity of opportunities in biomedical engineering. Each student completes a senior project, a hands-on experience. This year-long project may be explored as an individual, but the projects most often involve groups of students from biomedical engineering, other engineering or computer science departments, biological or medical departments, or engineers from corporations. Well-equipped laboratories emphasize measurement techniques and experimental methods. Each biomedical engineering student’s sequence of courses will vary according to credits taken in high school, ability level, individual preference and career goals.

In addition, all students in the biomedical engineering program are exposed to entrepreneurship and the entrepreneurial mindset through the curriculum and extracurricular
opportunities. The capstone course is designed to fully embed the student in a project that will challenge even the exceptional student to integrate their previous training and to develop their abilities as an engineer.

The flexibility available within the major offers students increased opportunity to experience research. More than 25 percent of our undergraduate student population take part in an organized research experience within the department.

Careers
As a biomedical engineer, there are a variety of career paths to choose from, including industrial or consulting positions; graduate school; and professional schools such as medicine, veterinary medicine or business administration. The curriculum allows students to specialize in and explore the biomedical engineering program, while still providing a solid background in biological/physical sciences, mathematics and basic engineering.

Program Requirements

Basic Science and Mathematics (38 credits)
CHEM 1110 General Chemistry I 3
CHEM 1115 General Chemistry I Lab 1
CHEM 1120 General Chemistry II 3
CHEM 1125 General Chemistry II Lab 1
BIOL 1240/1245 Biology I & Lab 4
PHYS 1610 Engineering Physics I 3
PHYS 1620 Engineering Physics I Lab 1
PHYS 1630 Engineering Physics II 3
PHYS 1640 Engineering Physics II Lab 1
MATH 1510 Calculus I 4
MATH 1520 Calculus II 4
MATH 2530 Calculus III 4
MATH 3550 Differential Equations 3
MATH 3850 Foundations of Statistics 3

Basic Engineering (11 credits)
BME 3200 Mechanics 3
ECE 2001 Electrical & Computer Eng 3
ECE 2002 Electrical & Computer Eng Lab 1
MENG 2011 Engineering Shop Practice 1
ESCI 2300 Engineering Thermodynamics 3

Written and Oral Communication (3 credits)
ENGL 1900 Adv Strategies of Rhet & Research 3

Liberal Arts (18 credits)
THEO 1000 Theological Foundations 3
PHIL 2050 Ethics 3
Humanities 3
Cultural Diversity 3
Social & Behavioral Sciences 3
Non-Technical Elective 3
Cultural Diversity elective courses must be selected from an approved Arts & Sciences list. See the description of the Parks College core above for more information.

Humanities courses include: Fine Arts (excludes applied, studio, and performance courses), Literature (ENGL 2020-2750, 3190-3740, 4130-4890), History, American Studies, and Foreign Languages (excludes English or native language).


Non-Technical Elective shall be chosen from: Philosophy, Theology, Humanities, or Social & Behavioral Sciences.

Biomedical Engineering Core (27 credits)
BME 1000 BME Orientation 1
BME 1010 BME Introduction 1
BME 2000 BME Computing 3
BME 2200 Applied Physiology for Engineers 3
BME 3100 Signals 3
BME 3300 Transport Fundamentals 3
BME 3400 Materials Science 3
BME 3840 Junior Lab 1
BME 3150 Biomedical Instrumentation 3
BME 4950/4960 Senior Project I & II 6

Advanced Biomedical Engineering (18 credits)
BME 4100 Biomedical Signals 3
BME 4200 Biomechanics 3
BME 4300 Biotransport 3
BME 4310 Advanced Topics in Biotransport 3
BME 4400 Biomaterials 3
BME 4410 Tissue Engineering 3
BME 4500 Numerical Methods in BME 3
BME 4600 Quantitative Physiology I 3
BME 4650 Quantitative Physiology II 3
BME 4980 Independent Research 3

BME-Related General Electives (9 credits)
BME-Related general electives should be selected in accordance with the student’s long-term educational and career goals. Often, students use these credits for advanced work in math, science, and engineering. However, students may also select courses designed to broaden their education in areas such as liberal arts or business. In all cases the permission of the academic advisor and Department Chairperson is required. Under no circumstances can prerequisite courses be used as general electives, e.g., Pre-Calculus (MATH 1400) or The Process of Composition (ENGL 1500).

TOTAL CREDITS: 124

Continuation Standards
The grades in all BME courses must be C- or better.
Students must maintain a minimum 2.00 GPA.

**BIOMEDICAL ENGINEERING MINOR**

**Program Requirements**

The minor requires 18 credits of coursework including a course in physiology (e.g., BIOL 2600, PPY 2540 Human Physiology or BME 2200) and at least five BME courses. At least three of the BME courses must be selected at the 4000-level, i.e., from the Advanced BME courses.

To initiate a Minor in BME, a student should file a "Minor in BME" plan with the BME Department after meeting with a BME Faculty member to discuss the minor courses and their prerequisites. The "Minor in BME" form serves as a planning tool and that will be on file in the BME Department and with the student's academic advisor in the major area. The completion of a Minor in BME must be certified by the Chair of the BME Department as part of the graduation check.

**Continuation Standards**

The grades in all BME minor courses must be C or better.

Students must maintain a minimum 2.00 GPA.
CIVIL ENGINEERING

LEADERSHIP
Ronaldo Luna, Ph.D., P.E.
Department Chair

OVERVIEW
Saint Louis University’s undergraduate major in civil engineering prepares you practice your skills in the real world by using project-based, hands-on learning methods. There is also an accelerated Bachelor of Science to Master of Science option available.

Faculty
Craig Adams, Ph.D., P.E.
Christopher Carroll, Ph.D., P.E.
Amanda Cox, Ph.D., P.E.
Riyadh Hindi, Ph.D., P.Eng.
Jalil Kianfar, Ph.D., P.E.

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

The undergraduate civil engineering program is accredited by the Engineering Accreditation Commission of ABET (http://www.abet.org).

Program Educational Objectives
The undergraduate program is designed to meet the following specific objectives in order to fulfill the departmental and institutional missions.

- Be employed as engineers or be enrolled in engineering or professional graduate school;
- Demonstrate their commitment to life-long learning and professional development through seeking professional licensure, pursuing graduate studies, or participating in other professional continuing education activities;
- Advance into leadership roles in their profession and in service to their communities; and
- Create design solutions that address economic, social, and environmental factors in their professional engineering practice.

Student Outcomes

Graduates of the Civil Engineering program at Saint Louis University will demonstrate:

a) an ability to apply knowledge of mathematics, science, and engineering;
b) an ability to design and conduct experiments, as well as to analyze and interpret data;
c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
d) an ability to function on multi-disciplinary teams;
e) an ability to identify, formulate, and solve engineering problems;
f) an understanding of professional and ethical responsibility;
g) an ability to communicate effectively;
h) the broad education necessary to understand the impact of engineering solutions in a global and societal context;
i) a recognition of the need for, and an ability to engage in life-long learning;
j) a knowledge of contemporary issues;
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;
l) apply knowledge of four technical areas appropriate to civil engineering;
m) explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.

Program Highlights
The civil engineering program offered by the department of civil engineering at Saint Louis University’s Parks College of Engineering, Aviation and Technology is future-focused, incorporating the latest trends in civil engineering to address the current and future needs of the profession and society.

Graduates are well-prepared to enter professional practice and have the comprehensive skill set and leadership background needed to address society’s needs at the local, regional and global level. The civil engineering curriculum emphasizes professional practice preparation using project-based, hands-on learning methods.

Some of the student organizations available for civil engineering majors to join include:

+ American Society of Civil Engineers: A
distinguished professional organization representing the civil engineering profession. Engineers Without Borders: Uses engineering as a way to help improve the lives of those living in economically developing nations.

Curriculum Overview
The civil engineering program provides a solid foundation of coursework in the engineering sciences, including structural, environmental, geotechnical, hydraulic and transportation engineering. Solid mechanics, fluid sciences and graphics are also covered.

Modern and well-equipped laboratories emphasize experimental methods and measurement techniques.

The civil engineering program includes the following primary focus areas:
+ Green and sustainable design
+ Infrastructures design, evaluation and restoration
+ Transportation planning, modeling and design
+ Hydraulic and water resources modeling and design

In addition, students are exposed to entrepreneurship and the entrepreneurial mindset through the curriculum and extracurricular opportunities.

Fieldwork and Research Opportunities
Benefits of the civil engineering program include several internship and career opportunities. Competitive summer internships and cooperative education programs are available within the industry and with government agencies. Independent study on a civil engineering topic can be arranged under the direction of a faculty member.

Located in the heart of St. Louis students gain access to a number of industry contacts from around the area. This allows students to easily partake in internships during the school year and network with professionals before graduation. Plus, the civil engineering faculty are very active in research and there are many opportunities for students to help conducting research during the academic year and summer.

Modern and well-equipped laboratories emphasize experimental methods and measurement techniques. The Civil Engineering laboratory facilities include a variety of equipment. In addition to the existing laboratory facilities in Oliver Hall, such as universal testing machines, vibration apparatus, and fluid dynamics laboratory; additional facilities include: soil mechanics, environmental, and construction materials testing laboratories. Students in the Civil Engineering program may specialize in areas such as infrastructure evaluation and design, transportation analysis and planning, and green engineering and sustainable design.

Careers
After graduation, students with a B.S. in civil engineering can pursue graduate study or enter one of the most dynamic industries in the United States. Industry and government agencies have long recognized the quality of engineering graduates from Parks College.

A few of the places where civil engineering graduates can find opportunities include:
+ Missouri and Illinois departments of transportation
+ Missouri Sewer District
+ State, county and municipal engineering offices
+ The Army Corps of Engineers
+ Private engineering firms such as Black and Veatch, Parsons, etc.
+ Construction companies
+ U.S. Air Force, Army and Navy

Program Requirements
Basic Science and Mathematics (26 credits)
CHEM 1110 General Chemistry I Lecture 3
CHEM 1115 General Chemistry I Lab 1
PHYS 1610 Engineering Physics I Lecture 3
PHYS 1620 Engineering Physics I Lab 1
MATH 1510 Calculus I 4
MATH 1520 Calculus II 4
MATH 2530 Calculus III 4
MATH 3550 Diff. Equations 3
STAT 3850 Foundations of Statistics 3

Math/Science Electives (7 credits)
The Math and Science elective cannot be a prerequisite course for required courses in the curriculum.

Either BIOL 1240 Principles of Biology I/BIOL 1245 Principles of Biology I Laboratory or an EAS course (or both) must be taken to satisfy the ABET basic science requirement.

Acceptable EAS courses include: EAS1010 Earth Systems I-The Solid Earth/EAS1020 Earth’s Environment I Lab, EAS1030 Earth’s Dynamic Environment II/EAS1040 Earth’s Environment II Lab, EAS1050 Introduction to Oceanography, EAS1090 Climate Change, EAS2300 Geology for
Civil Engineering Courses (ESCI)

- ESCI 2100 Statics
- ESCI 2150 Dynamics
- ESCI 3100 Mechanics of Solids
- ESCI 3101 Mechanics of Solids Lab
- ESCI 3200 Fluid Dynamics
- ESCI 3201 Fluid Dynamics Lab

Civil Engineering Courses (44 credits)

- CVNG 1010 Freshman Engineering I
- CVNG 1020 Freshman Engineering II
- CVNG 1500 Civil Engineering Computing
- CVNG 2010 GIS and Surveying in Civil Engr.
- CVNG 2020 GIS and Surveying Lab
- CVNG 3040 Sustainability & Environmental Engr.
- CVNG 3041 Sustainability & Envir. Engr. Lab
- CVNG 3010 Structural Analysis
- CVNG 3020 Structural Analysis Lab
- CVNG 3030 Civil Engineering Materials
- CVNG 3070 Engineering Project Management
- CVNG 3090 Geotechnical Engineering
- CVNG 3100 Geotechnical Engineering Lab
- CVNG 3110 Transportation Engineering
- CVNG 3120 Transportation Engineering Lab
- CVNG 3130 Hydraulic Engineering

Written and Oral Communication (4 credits)

- ENGL 1920 Advanced Writing for Professionals
- CMM 2200 Small Group Presentation

Liberal Arts (15 credits)

- THEO 1000 Theological Foundations
- PHIL 3400 Engineering Ethics
- Humanistic Values Electives
- Cultural Diversity Elective

Civil Engineering Electives (9 credits)

- CVNG 3140 Hydraulic Engineering Lab
- CVNG 3150 Introduction to Structural Design
- CVNG 3160 Introduction to Structural Design Lab
- CVNG 4500 Capstone Design I
- CVNG 4510 Capstone Design II

Professional Development Electives (6 credits)

- CVNG 4500 Professional Development Electives (6 credits)
- CVNG 4510 Sustainable Land Development Engr.
- CVNG 4210 Sustainable Water Management
- CVNG 4330 Open-Channel Flow
- CVNG 4350 Hydraulic Modeling
- CVNG 4370 River Engineering

TOTAL CREDITS: 125

Continuation Standards

Students must maintain a minimum 2.00 GPA.
ELECTRICAL AND COMPUTER ENGINEERING

LEADERSHIP
William J. Ebel, Ph.D.
Department Chair

Faculty
Roobik Gharabagi, Ph.D.
Armineh Khalili, M.S.E.E.
Huliyar S. Mallikarjuna, Ph.D.
Kyle Mitchell, Ph.D.
Habib Rahman, Ph.D.

OVERVIEW
The Department of Electrical and Computer Engineering offers two undergraduate programs leading to the degree of Bachelor of Science in Electrical Engineering or Computer Engineering. The department provides programs that incorporate analysis, design and development of electrical, electronic, and computer systems, and prepares graduates for entry into the profession as productive and effective engineers.

BACHELOR OF SCIENCE IN COMPUTER ENGINEERING

The undergraduate computer engineering program is accredited by the Engineering Accreditation Commission of ABET (http://www.abet.org).

Program Educational Objectives
The undergraduate program is designed to meet the following specific objectives in order to fulfill the departmental and institutional missions.

- Our graduates will have acquired advanced degrees or are engaged in advanced study in engineering, business, law, medicine or other appropriate fields.
- Our graduates will have established themselves as practicing engineers in electrical, computer or related engineering fields.
- Our graduates will be filling the technical needs of society by solving engineering problems using electrical or computer engineering principles, tools, and practices.

Student outcomes are defined by ABET as the skills that graduates will attain at the time of graduation. Student outcomes are listed below:

a. an ability to apply knowledge of mathematics, science, and engineering;

b. an ability to design and conduct experiments, as well as to analyze and interpret data;

c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;

d. an ability to function on multi-disciplinary teams;

e. an ability to identify, formulate, and solve engineering problems;

f. an understanding of professional and ethical responsibility;

g. an ability to communicate effectively;

h. the broad education necessary to understand the impact of engineering solutions in a global and societal context;

i. a recognition of the need for, and an ability to engage in life-long learning;

j. a knowledge of contemporary issues;

k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Program Highlights
The department offers a unique, hands-on undergraduate program culminating in a Bachelor of Science in computer engineering. The department provides a curriculum that incorporates analysis, design and development of computer systems containing hardware and software components.

The curriculum provides graduates with necessary skills for entry into the profession as productive and effective engineers or to pursue graduate education.

An additional feature of the program is that all students are exposed to entrepreneurship and the entrepreneurial mindset through the curriculum and extracurricular opportunities.

Additional program highlights include:

+ The hands-on nature of the curriculum allows computer engineering students to apply theoretical concepts to practical applications. Students begin conducting experiments in department labs during their freshman year.
+ Students have the opportunity to work with faculty on research programs, enhancing their educational experience and preparing them for industry.
+ Computer engineering students are given a well-rounded approach that teaches not only technical skills but the business side of engineering as well.

Curriculum Overview
The program coursework provides students with both breadth and depth in computer engineering. The program develops a student's ability to apply knowledge of mathematics, sciences and computer engineering to find solutions to practical problems. It ensures that graduates have an opportunity to work on multidisciplinary teams and develop effective communication skills.

In addition to a strong focus on computer skills and computer hardware and software, the program provides a broad design experience which is integrated throughout the program by introducing fundamental elements of the design process in coursework. The program also includes a two-semester design sequence to provide a meaningful and significant engineering design experience that focuses on and prepares students for professional practice.

Fieldwork and Research Opportunities
Benefits of the computer engineering program also include several internship, research and career opportunities. Students are encouraged and assisted in obtaining summer internships with local and global companies through career services.

Undergraduate research opportunities within the college and National Science Foundation-sponsored research activities are available during summer or regular semesters. Undergraduate students are also encouraged to seek opportunities for research with faculty of the department or faculty in other departments.

Careers
As a computer engineer, there are a variety of career paths spanning industrial or consulting positions. Students are also prepared for graduate school and professional schools such as law, business administration or medicine.

Graduates have found employment at such companies as:
+ Amazon
+ AT&T
+ Boeing
+ Department of Defense
+ Emerson Electric
+ Garmin
+ General Motors
+ Intel
+ Rockwell
+ Samsung
+ Texas Instruments
+ U.S. Air Force

Program Requirements
Basic Science and Mathematics Requirements (36 credits)
CHEM 1110 General Chemistry I 3
CHEM 1115 General Chemistry I Lab 1
PHYS 1610 Engineering Physics I 3
PHYS 1620 Engineering Physics I Lab 1
PHYS 1630 Engineering Physics II 3
PHYS 1640 Engineering Physics II Lab 1
MATH 1660 Discrete Mathematics 3
MATH 1510 Calculus I 4
MATH 1520 Calculus II 4
MATH 2530 Calculus III 4
MATH 3110 Linear Algebra 3
MATH 3550 Differential Equations 3
ECE 3052 Probability & RV for Engineers 3

Written and Oral Communication (3 credits)
ENGL 1920 Adv Writing for Professionals 3

Computer Science (14 credits)
CSCI 1300 Intro Object Oriented Program 4
CSCI 2100 Data Structures 4
CSCI 2300 Object Oriented Software Design 3
CSCI 3500 Operating Systems 3

Liberal Arts Requirements (15 credits)
PHIL 3400 Ethics and Engineering 3
THEO 1000 Theological Foundations 3
Cultural Diversity 3
Humanities 3
Social & Behavioral Science 3
Cultural Diversity, Humanities, Social and Behavioral Science must be selected from an approved list.

Computer Engineering Core (48 credits)
ECE 1001 Intro to ECE I 1
ECE 1002 Intro to ECE II 1
ECE 2101 Electrical Circuits I 3
ECE 2102 Electrical Circuits II 3
ECE 2103 Electrical Circuits Lab 1
ECE 2205 Digital Design 3
ECE 2206 Digital Design Lab 1
ECE 3205 Advanced Digital Design 3
ECE 3215 Computer Systems Design 3
ECE 3215 Computer Systems Design Lab 1
ECE 3217 Computer Architecture 3
ECE 3225 Microprocessors 3
ECE 3226 Microprocessors Lab 1
ECE 3130 Semiconductor Devices 3
ECE 3131 Electronic Circuits 3
ECE 3132 Electronic Circuits Lab 1
ECE 3150 Linear Systems 3
ECE 3151 Linear Systems Lab 1
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ECE 3090 Junior Design 1
ECE 4245 Computer Networks 3
ECE 4800 ECE Design I 3
ECE 4810 ECE Design II 3

ECE or CSCI Electives (6 credits)

Students are required to take six (6) credits from an approved list and as offered. A partial list is given below. Please check with the ECE department for a complete list of approved electives.

ECE 3110 Energy Conversion 3
ECE 3140 Electromagnetic Fields 3
ECE 4225 Hardware Software Co-design 3
ECE 4226 Mobile Robotics 3
ECE 4235 Digital IC Design 3
ECE 4151 Digital Signal Processing 3
CSCI 3100 Algorithms 3
CSCI 3200 Programming Languages 3
CSCI 3820 Computer Graphics I 3
CSCI 3710 Databases 3
CSCI 3200 Software Engineering 3
CSCI 4550 Advanced Operating Systems 3
CSCI 3760 Artificial Intelligence 3

Technical Elective (3 credits)
One 3 credit course selected from an approved list in science, mathematics, or engineering, at the 2000-level or higher, or Computer Science at 3000 or higher.

Internship and Co-op
Although not required, students can elect to participate in an internship or cooperative experience before graduation.

ECE 2910 Co-op 0-3
ECE 3910 Co-op 0-3
ECE 4910 Co-op 0-3
ECE 2915 Internship 0-3
ECE 3915 Internship 0-3
ECE 4915 Internship 0-3

TOTAL CREDITS: 125

Continuation Standards
Students must maintain a minimum 2.00 GPA.

Bachelor of Science in Electrical Engineering

The undergraduate electrical engineering program is accredited by the Engineering Accreditation Commission of ABET (http://www.abet.org).

Program Educational Objectives

The undergraduate program is designed to meet the following specific objectives in order to fulfill the departmental and institutional missions.

- Our graduates will have acquired advanced degrees or are engaged in advanced study in engineering, business, law, medicine or other appropriate fields.
- Our graduates will have established themselves as practicing engineers in electrical, computer or related engineering fields.
- Our graduates will be filling the technical needs of society by solving engineering problems using electrical or computer engineering principles, tools, and practices.

Student Outcomes

Student outcomes are defined by ABET as the skills that graduates will attain at the time of graduation. Student outcomes are listed below:

a. an ability to apply knowledge of mathematics, science, and engineering;
b. an ability to design and conduct experiments, as well as to analyze and interpret data;
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
d. an ability to function on multi-disciplinary teams;
e. an ability to identify, formulate, and solve engineering problems;
f. an understanding of professional and ethical responsibility;
g. an ability to communicate effectively;
h. the broad education necessary to understand the impact of engineering solutions in a global and societal context;
i. a recognition of the need for, and an ability to engage in life-long learning;
j. a knowledge of contemporary issues;
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Program Highlights

The department offers a unique undergraduate program culminating in a Bachelor of Science in electrical engineering. The curriculum provides graduates with the necessary skills for entry into the profession as productive and effective engineers or for pursuing graduate school.

Additionally, the program ensures all students are exposed to entrepreneurship and the entrepreneurial mindset through the curriculum.
and extracurricular opportunities.

A Bachelor of Science (B.S.) in electrical engineering can also be obtained with the following options:

+ Bachelor of Science (B.S.) in electrical engineering, emphasis in bioelectronics (pre-med)
+ Bachelor of Science (B.S.) in electrical engineering, emphasis in bioelectronics (engineering emphasis)

The Bioelectronics concentration is a joint effort by the Electrical and Computer Engineering Department and the Biomedical Engineering Department of Parks College. The course of study combines science and engineering, incorporating courses in biology, chemistry, math, biomedical engineering, electrical and electronic engineering, and others. Students in the Bioelectronics track will pursue either of two emphases, engineering or pre-health, and will graduate with a B.S. in Electrical Engineering and coursework in Biomedical Engineering.

Curriculum Overview
The program coursework provides students with both breadth and depth in electrical engineering. The program develops in students the ability to apply knowledge of mathematics, sciences and electrical engineering to find solutions to practical problems. It ensures that graduates have an opportunity to work on multidisciplinary teams and develop effective communication skills.

In addition to a strong focus on core areas of electrical engineering, the program provides a design experience that is integrated throughout the program by introducing fundamental elements of the design process throughout student coursework. The program also includes a two-semester design sequence to provide a meaningful and significant engineering design experience that focuses on and prepares students for professional practice.

Fieldwork and Research Opportunities
Benefits of the electrical engineering program also include several internship and career opportunities. Students are encouraged and assisted in obtaining summer internships in local and global companies through career services. Undergraduate research opportunities within the college and National Science Foundation-sponsored research activities are available during summer or regular semesters.

Students are also encouraged to seek research opportunities with faculty of the department or faculty in other departments.

Careers
As an electrical engineer, there are a variety of career paths open to you, including industrial or consulting positions. Our students are also prepared for graduate and professional schools such as law, business administration or medicine.

Our graduates have found employment at companies and government agencies such as:

+ Boeing
+ Emerson Electric
+ Intel
+ Rockwell
+ Space-X
+ Tellabs
+ Texas Instruments
+ U.S. Air Force

When students graduate from the program with the bioelectronics concentration in electrical engineering will find a wealth of career opportunities in the bioengineering industry. Examples are hospital clinical engineering, medical device manufacturing/vendors, healthcare research and design centers, and medical/university laboratories.

Students pursing the pre-health emphasis are well prepared to enter a highly challenging and rewarding field of medicine. Bioelectronics with pre-health emphasis provides an excellent opportunity for future medical doctors to be well versed in technological advances. It allows for much greater integration and innovation of technology in medicine, for example the uses of MRI and CT scans.

Program Requirements

Basic Science and Mathematics Requirements (39 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 1110</td>
<td>General Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 1115</td>
<td>General Chemistry I Lab</td>
<td>1</td>
</tr>
<tr>
<td>PHYS 1610</td>
<td>Engineering Physics I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 1620</td>
<td>Engineering Physics I Lab</td>
<td>1</td>
</tr>
<tr>
<td>PHYS 1630</td>
<td>Engineering Physics II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 1640</td>
<td>Engineering Physics II Lab</td>
<td>1</td>
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<tr>
<td>MATH 1660</td>
<td>Discrete Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>MATH 1510</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1520</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 2530</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 3110</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 3550</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>ECE 3052</td>
<td>Probability &amp; RV for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>ESCI 2300</td>
<td>Thermodynamics</td>
<td>3</td>
</tr>
</tbody>
</table>
Although not required, students can elect to participate in an internship or cooperative experience before graduation.

**ECE 2910 Co-op** 0-3
**ECE 3910 Co-op** 0-3
**ECE 4910 Co-op** 0-3
**ECE 2915 Internship** 0-3
**ECE 3915 Internship** 0-3
**ECE 4915 Internship** 0-3

**TOTAL CREDITS: 125**

### Bioelectronics Concentration (Engineering Emphasis)

#### Basic Science and Mathematics Requirements (51 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 1240/1245 Biology I &amp; Lab</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 1260/1265 Biology II &amp; Lab</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 2600 Human Physiology</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 1110 General Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 1115 General Chemistry I Lab</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 1120 General Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 1125 General Chemistry II Lab</td>
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</tr>
<tr>
<td>PHYS 1610 Engineering Physics I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 1620 Engineering Physics I Lab</td>
<td>1</td>
</tr>
<tr>
<td>PHYS 1630 Engineering Physics II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 1640 Engineering Physics II Lab</td>
<td>1</td>
</tr>
<tr>
<td>MATH 1660 Discrete Math</td>
<td>3</td>
</tr>
<tr>
<td>MATH 1510 Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1520 Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 2530 Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 3110 Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 3550 Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>ECE 3025 Probability &amp; RV for Engineers</td>
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</tr>
</tbody>
</table>

#### Liberal Arts Requirements (15 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>PHIL 3400 Ethics and Engineering</td>
<td>3</td>
</tr>
<tr>
<td>THEO 1000 Theological Foundations</td>
<td>3</td>
</tr>
<tr>
<td>Cultural Diversity</td>
<td>3</td>
</tr>
<tr>
<td>Humanities</td>
<td>3</td>
</tr>
<tr>
<td>Social &amp; Behavioral Science</td>
<td>3</td>
</tr>
<tr>
<td>Cultural Diversity, Humanities, Social and Behavioral Science</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Electrical Engineering Core (41 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 1001 Intro to ECE I</td>
<td>1</td>
</tr>
<tr>
<td>ECE 1002 Intro to ECE II</td>
<td>1</td>
</tr>
<tr>
<td>ECE 2101 Electrical Circuits I</td>
<td>3</td>
</tr>
<tr>
<td>ECE 2102 Electrical Circuits II</td>
<td>3</td>
</tr>
<tr>
<td>ECE 2103 Electrical Circuits Lab</td>
<td>1</td>
</tr>
<tr>
<td>ECE 2205 Digital Design</td>
<td>3</td>
</tr>
<tr>
<td>ECE 2206 Digital Design Lab</td>
<td>3</td>
</tr>
<tr>
<td>ECE 3110 Electric Energy Conversion</td>
<td>3</td>
</tr>
<tr>
<td>ECE 3225 Microprocessors</td>
<td>3</td>
</tr>
<tr>
<td>ECE 3132 Microprocessors Lab</td>
<td>3</td>
</tr>
<tr>
<td>ECE 3130 Semiconductor Devices</td>
<td>3</td>
</tr>
<tr>
<td>ECE 3131 Electronic Circuit Design</td>
<td>3</td>
</tr>
<tr>
<td>ECE 3140 Electromagnetic Fields</td>
<td>3</td>
</tr>
<tr>
<td>ECE 3150 Linear Systems</td>
<td>1</td>
</tr>
<tr>
<td>ECE 3151 Linear Systems Lab</td>
<td>3</td>
</tr>
<tr>
<td>ECE 3090 Junior Design</td>
<td>3</td>
</tr>
<tr>
<td>ECE 410 Automatic Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4100 Communication Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4800 ECE Design I</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4810 ECE Design II</td>
<td>3</td>
</tr>
</tbody>
</table>

#### ECE Electives (6 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 3227 Computer Architecture &amp; Organization</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4100 Energy Technologies I</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4110 Power Systems Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4153 Image Processing</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4126 Mobile Robotics</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4132 Analog IC Design</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4235 Digital IC Design</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4140 Radar Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4245 Computer Networks Design</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4150 Filter Design</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4151 Digital Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4161 Satellite Communications</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4162 Cellular Communications</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Open Elective (3 credits)

One 3-credit course satisfying another minor/major or must satisfy the requirements of a technical elective.

#### Technical Elective (6 credits)

Two 3-credit courses selected from an approved list in science, mathematics, Computer Science, or engineering, at the 2000-level or higher.

### Internship and Co-op

Although not required, students can elect to participate in an internship or cooperative experience before graduation.
BME 2000 BME Computing 3
BME 3150 Biomedical Instrumentation 3
BME 4100 Biomedical Signals 3

BME or ECE Electives (6 credits)
BME 4200 Biomechanics 3
BME 4300 Biotransport 3
BME 4310 Advanced Topics in Biotransport 3
BME 4400 Biomaterials 3
BME 4410 Tissue Engineering 3
BME 4500 Numerical Methods in BME 3
BME 4600 Quantitative Physiology I 3
BME 4650 Quantitative Physiology II 3
BME 4930 Independent Research 3
ECE 4170 Energy Technologies I 3
ECE 4110 Power Systems Analysis I 3
ECE 4153 Image Processing 3
ECE 4226 Mobile Robotics 3
ECE 4132 Analog IC Design 3
ECE 4235 Digital IC Design 3
ECE 4141 Radar Systems 3
ECE 4245 Computer Networks Design 3
ECE 4150 Filter Design 3
ECE 4151 Digital Signal Processing 3
ECE 4161 Satellite Communications 3
ECE 4162 Cellular Communications 3

Internship and Co-op
Although not required, students can elect to participate in an internship or cooperative experience before graduation.

ECE 2910 Co-op 0-3
ECE 3910 Co-op 0-3
ECE 4910 Co-op 0-3
ECE 2915 Internship 0-3
ECE 3915 Internship 0-3
ECE 4915 Internship 0-3

TOTAL CREDITS: 125

Bioelectronics Concentration (Pre-Health Emphasis)

Basic Science and Mathematics Requirements (56 credits)
BIOL 1240/1245 Biology I & Lab 4
BIOL 1260/1265 Biology II & Lab 4
CHEM 1110 General Chemistry I 3
CHEM 1115 General Chemistry I Lab 1
CHEM 1120 General Chemistry II 3
CHEM 1125 General Chemistry II Lab 1
CHEM 2410 Organic Chemistry 3
CHEM 2415 Organic Chemistry Lab 1
CHEM 2420 Organic Chemistry II 3
CHEM 2425 Organic Chemistry II Lab 1
CHEM 3600 Biochemistry 3
PHYS 1610 Engineering Physics I 3
PHYS 1620 Engineering Physics I Lab 1
PHYS 1630 Engineering Physics II 3
PHYS 1640 Engineering Physics II Lab 1
MATH 1660 Discrete Math 3
MATH 1510 Calculus I 4
MATH 1520 Calculus II 4
MATH 2530 Calculus III 4
MATH 3550 Differential Equations 3
ECE 3052 Probability & RV for Engineers 3
ENGL 1900 Advanced Rheotoric 3

Liberal Arts Requirements (18 credits)
PHIL 3400 Ethics and Engineering 3
THEO 1000 Theological Foundations 3
Cultural Diversity 3
Humanities: English Literature Elective 3
PSY 1010 Intro to Psychology 3
SOC 1100 Intro to Sociology 3

Electrical Engineering Core (41 credits)
ECE 1001 Intro to ECE I 1
ECE 1002 Intro to ECE II 1
ECE 2101 Electrical Circuits I 3
ECE 2102 Electrical Circuits II 3
ECE 2103 Electrical Circuits Lab 1
ECE 2205 Digital Design 3
ECE 2206 Digital Design Lab 1
ECE 3225 Microprocessors 3
ECE 3226 Microprocessors Lab 1
ECE 3330 Semiconductor Devices 3
ECE 3331 Electronic Circuit Design 3
ECE 3332 Electronic Circuit Design Lab 1
ECE 3310 Electromagnetic Fields 3
ECE 3315 Linear Systems 3
ECE 3315 Linear Systems Lab 1
ECE 3090 Junior Design 1
ECE 4120 Automatic Control Systems 3
ECE 4800 ECE Design I 3
ECE 4810 ECE Design II 3

Biomedical Engineering Core (3 credits)
BME 2000 BME Computing 3

BME or ECE Electives (3 credits)
BME 3150 Biomedical Instrumentation 3
BME 4100 Biomedical Signals 3
BME 4200 Biomechanics 3
BME 4300 Biotransport 3
BME 4310 Advanced Topics in Biotransport 3
BME 4400 Biomaterials 3
BME 4410 Tissue Engineering 3
BME 4500 Numerical Methods in BME 3
BME 4600 Quantitative Physiology I 3
BME 4650 Quantitative Physiology II 3
BME 4980 Independent Research 3
ECE 3110 Energy Conversion 3
ECE 3140 Electromagnetic Fields 3
ECE 4225 Hardware Software Co-design 3
ECE 4226 Mobile Robotics 3
ECE 4235 Digital IC Design 3
ECE 4151 Digital Signal Processing 3

TOTAL CREDITS: 130

Continuation Standards
Students must maintain a minimum 2.00 GPA.
PHYSICS

LEADERSHIP
William D. Thacker, Ph.D.
Department Chair

Faculty
Gregory L. Comer, Ph.D.
Vijai V. Dixit, Ph.D.
John C. James, Ph. D.
Irma Kuljanishvili, Ph.D.
Martin Nikolo, Ph. D.
Jean Potvin, Ph.D.
Ian H. Redmount, Ph.D.
Thalanayar S. Santhanam, Ph.D.
Dmitry Solenov, Ph.D.
William D. Thacker, Ph.D.
David Wisbey, Ph.D.

OVERVIEW
The Department of Physics offers two undergraduate degrees in Physics: the Bachelor of Science (B. S.) degree for students enrolled in Parks College and the Bachelor of Arts (B. A.) degree for students in the College of Arts and Sciences. The department also offers a Bachelor of Science (B. S.) degree in Engineering Physics for students enrolled in Parks College. In addition, the department offers Minors in Physics, useful primarily to students majoring in mathematics, computer science, engineering fields, and other sciences. Major-minor links between physics and other disciplines provide opportunities for students to acquire valuable analytical and problem-solving skills and to distinguish themselves from others pursuing similar career paths.

BACHELOR OF ARTS IN PHYSICS

Program Highlights
Physics is the branch of science that studies the nature of matter, energy and spacetime at the most fundamental level. It provides a foundation for all the natural sciences and engineering disciplines. Physics has brought such revolutions as relativity, quantum mechanics and the Big Bang theory, profoundly altering the way mankind views the universe.

Physicists have played a major role in the discovery of many phenomena leading to whole new technologies. The invention of the transistor, by physicists, has made the modern computer possible, while the development of lasers has led to diverse applications ranging from supermarket scanners to laser surgery. The physicist is a versatile problem solver and able to excel in many technical fields.

A training in physics leads to a broad-based understanding of natural phenomena, analytical and computer skills, experience with electronics and the operation of sophisticated equipment, an understanding of measurements and their limitations, and the ability to formulate and solve technical problems.

Physics students have a strong interest in mathematics, computers and science along with a desire to understand how the universe works. Students are interested in questions such as “Why do elementary particles behave the way they do?”, “What is the nature of light?” or “How did the universe begin, and what will eventually happen to it?” Some students pursue double majors in mathematics, computer science or an engineering field.

Curriculum Overview
The B.A. in physics from the College of Arts and Sciences combines a firm grounding in physics with a broad liberal education.

Students of the physics program gain a solid foundation in analytical, computational and laboratory skills through course work in mathematics, computer science and physics. The physics curriculum includes courses in classical mechanics, quantum mechanics, electricity and magnetism, thermodynamics and statistical mechanics, as well as optics, electronics and modern physics.

The required courses listed below are accompanied by the Parks College core. This degree is conferred by Parks College. This curriculum also satisfies all requirements for a Minor in Engineering Mathematics.

Fieldwork and Research Opportunities
Benefits of the physics program also include several internship and career opportunities. The physics department employs some of its students as teaching and research assistants during the summer. Students have held summer internships at NASA-Langley, the Argonne National Laboratory and other laboratories. Students have worked both during the summer and during the year at local industries such as Boeing and Anheuser-Busch. Numerous opportunities exist for summer research.
in basic and applied physics in the Parks Summer Undergraduate Research Experience (SURE) program and in national laboratories and in National Science Foundation-sponsored programs at universities throughout the United States.

The programs stresses undergraduate research and applications of computers in physics. New state-of-the-art research facilities allow for students to work directly alongside faculty members on research projects.

**Careers**

Graduates with a bachelor’s degree in physics enter a variety of careers that depend on the technical skills gained in college. Alumni are employed in product development and quality control in large industries such as RCA, Boeing or Lockheed-Martin. Alumni are computer specialists at Anheuser-Busch and other companies. Some are now involved in the marketing of technical products, while others are in management positions. A few graduates have entered military careers. Students frequently earn double majors, combining physics with mathematics, computer science or chemistry.

**Program Requirements**

**Prerequisites (28 credits)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 1110/1115 General Chemistry I/Lab</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1510 Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1520 Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 2530 Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 1110 Introduction to Physics</td>
<td>1</td>
</tr>
<tr>
<td>PHYS 1610/1620 Engineering Physics I/Lab</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 1630/1640 Engineering Physics II/Lab</td>
<td>4</td>
</tr>
<tr>
<td>CSCI 1060 Intro. to CS: Scientific Programming</td>
<td>3</td>
</tr>
</tbody>
</table>

**Required Physics & Mathematics Courses (25 credits):**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 2660 Principles of Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>MATH 3120 Introduction to Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 3550 Differential Equations I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 4310 Introduction to Complex Variables</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 2610/2620 Modern Physics/Lab</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 3110 Classical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 4210 Electricity &amp; Magnetism</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 4610 Quantum Mechanics</td>
<td>3</td>
</tr>
</tbody>
</table>

**Additional Requirements (6 credits):**

- 2 upper division physics courses from the list below:
  - PHYS 3120 Advanced Classical Mechanics
  - PHYS 3310 Optics/Lab
  - PHYS 3410 Thermodynamics & Statistical Mechanics
  - PHYS 3510 Analog & Digital Electronics/Lab
  - PHYS 3610 Modern Physics II
  - PHYS 4010 Nanoscience and Nanofabrication Frontiers
  - PHYS 4020 Experimental Physics
  - PHYS 4210 Electricity and Magnetism II
  - PHYS 4620 Application of Quantum Mechanics

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior Inquiry (0-3 credits)</td>
<td></td>
</tr>
</tbody>
</table>

**Bachelor of Science in Physics**

**Program Highlights**

Physics is the branch of science that studies the nature of matter, energy and spacetime at the most fundamental level. It provides a foundation for all the natural sciences and engineering disciplines. Physics has brought such revolutions as relativity, quantum mechanics and the Big Bang theory, profoundly altering the way mankind views the universe.

Physicists have played a major role in the discovery of many phenomena leading to whole new technologies. The invention of the transistor, by physicists, has made the modern computer possible, while the development of lasers has led to diverse applications ranging from supermarket scanners to laser surgery. The physicist is a versatile problem solver and able to excel in many technical fields.

A training in physics leads to a broad-based understanding of natural phenomena, analytical and computer skills, experience with electronics and the operation of sophisticated equipment, an understanding of measurements and their limitations, and the ability to formulate and solve technical problems.

Physics students have a strong interest in mathematics, computers and science along with a desire to understand how the universe works. Students are interested in questions such as “Why do elementary particles behave the way they do?”, “What is the nature of light?” or “How did the universe begin, and what will eventually happen to it?”. Some students pursue double majors in mathematics, computer science or an engineering field.

**Curriculum Overview**

The B.S. in physics from Parks College stresses physics and its applications in areas such as engineering, computers and the sciences, and also includes opportunities to participate in faculty research.
Students of the physics program gain a solid foundation in analytical, computational and laboratory skills through course work in mathematics, computer science and physics. The physics curriculum includes courses in classical mechanics, quantum mechanics, electricity and magnetism, thermodynamics and statistical mechanics, as well as optics, electronics and modern physics.

Fieldwork and Research Opportunities
Benefits of the physics program also include several internship and career opportunities. The physics department employs some of its students as teaching and research assistants during the summer. Students have held summer internships at NASA-Langley, the Argonne National Laboratory and other laboratories. Students have worked both during the summer and during the year at local industries such as Boeing and Anheuser-Busch. Numerous opportunities exist for summer research in basic and applied physics in the Parks Summer Undergraduate Research Experience (SURE) program and in national laboratories and in National Science Foundation-sponsored programs at universities throughout the United States.

The programs stresses undergraduate research and applications of computers in physics. New state-of-the-art research facilities allow for students to work directly alongside faculty members on research projects.

Careers
Graduates with a bachelor's degree in physics enter a variety of careers that depend on the technical skills gained in college. Alumni are employed in product development and quality control in large industries such as RCA, Boeing or Lockheed-Martin. Alumni are computer specialists at Anheuser-Busch and other companies. Some are now involved in the marketing of technical products, while others are in management positions. A few graduates have entered military careers. Students frequently earn double majors, combining physics with mathematics, computer science or chemistry.

Program Requirements

**Prerequisites (28 credits)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 1110</td>
<td>Introduction to Physics</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 1110/1115</td>
<td>General Chemistry I/Lab</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 1610/1620</td>
<td>Engineering Physics I/Lab</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 1630/1640</td>
<td>Engineering Physics II/Lab</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1510</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1520</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 2530</td>
<td>Calculus III</td>
<td>4</td>
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</tbody>
</table>

**Required Physics & Mathematics Courses (39 credits)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 2610</td>
<td>Modern Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 2620</td>
<td>Modern Physics Lab</td>
<td>1</td>
</tr>
<tr>
<td>PHYS 3110</td>
<td>Classical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 3610</td>
<td>Modern Physics II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 4210</td>
<td>Electricity &amp; Magnetism I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 4610</td>
<td>Quantum Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 3310/3320</td>
<td>Optics/Lab</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 3410</td>
<td>Thermodynamics &amp; Statistical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 3510</td>
<td>Analog &amp; Digital Electronics/Lab</td>
<td>4</td>
</tr>
<tr>
<td>MATH 3550</td>
<td>Differential Equations I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 3270</td>
<td>Advanced Mathematics for Engineers</td>
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</tr>
<tr>
<td>MATH 3850</td>
<td>Foundations of Statistics</td>
<td>3</td>
</tr>
<tr>
<td>MATH 3240</td>
<td>Numerical Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

**Additional Requirements (6 credits)**

Two additional upper division physics courses (minimum 6 credits) selected from the list below:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 3120</td>
<td>Advanced Classical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 4220</td>
<td>Electricity &amp; Magnetism II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 4620</td>
<td>Application of Quantum Mechanics</td>
<td>3</td>
</tr>
</tbody>
</table>

**Research Experience (3 credits)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>PHYS 3860</td>
<td>Physics Research I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 4870</td>
<td>Physics Research II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 4880</td>
<td>Physics Research III</td>
<td>3</td>
</tr>
</tbody>
</table>

**Allied Electives (21 credits)**

Seven Courses Selected with Mentor

**College Core (22 credits)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 1900</td>
<td>Adv. Rhet. &amp; Research or 1920 Adv. Writing</td>
<td>3</td>
</tr>
<tr>
<td>CMM 2200</td>
<td>Small Group Presentation</td>
<td>1</td>
</tr>
<tr>
<td>THEO 1000</td>
<td>Theological Foundations</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 2050</td>
<td>Ethics</td>
<td>3</td>
</tr>
<tr>
<td>Social/Behavioral Science Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Humanities Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>General Elect (Soc./Behav. or Humanities)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Cultural Diversity Elective</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
| Cultural Diversity, Humanities, and Social/Behavioral Science elective courses must be selected from an approved list. See the Parks College introduction in this catalog for more information.

**Open Elective (3 credits)**

One Course

**TOTAL CREDITS: 122**

**Continuation Standards**

Students must have a GPA of 2.0 in Physics major/minor coursework to be retained in the major/minor.

**Bachelor of Science in Engineering Physics**
The undergraduate engineering physics program is accredited by the Engineering Accreditation Commission of ABET (http://www.abet.org).

Program Educational Objectives
The undergraduate program is designed to meet the following specific objectives in order to fulfill the departmental and institutional missions. By three to five years after graduation, graduates of the engineering physics program will be:

- Engaged in successful public or private sector careers in engineering physics or a related field or as students pursuing advanced or professional degrees
- Collaborating effectively on multi-disciplinary teams and communicating effectively both within the team and with stakeholders
- Advancing in their professional careers through taking on increasing responsibilities, pursuing lifelong learning, continuing professional development, and seeking professional registration as appropriate for their employers
- Acting responsibly, ethically and in the service of humanity when making personal and professional decisions

Student Outcomes

a. an ability to apply knowledge of mathematics, science, and engineering;
b. an ability to design and conduct experiments, as well as to analyze and interpret data;
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
d. an ability to function on multi-disciplinary teams;
e. an ability to identify, formulate, and solve engineering problems;
f. an understanding of professional and ethical responsibility;
g. an ability to communicate effectively;
h. the broad education necessary to understand the impact of engineering solutions in a global and societal context;
i. a recognition of the need for, and an ability to engage in life-long learning;
j. a knowledge of contemporary issues;
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Program Highlights
Physics is the branch of science that studies the nature of matter, energy and spacetime at the most fundamental level. It provides a foundation for all the natural sciences and engineering disciplines. Physics has brought such revolutions as relativity, quantum mechanics and the Big Bang theory, profoundly altering the way mankind views the universe.

Physicists have played a major role in the discovery of many phenomena leading to whole new technologies. The invention of the transistor, by physicists, has made the modern computer possible, while the development of lasers has led to diverse applications ranging from supermarket scanners to laser surgery. The physicist is a versatile problem solver and able to excel in many technical fields.

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**Program Requirements (Interdisciplinary Option)**

**Professional Orientation (1 credit)**

- PHYS 1110 Introduction to Physics 1
- AENG/MENG 1001 Introduction to AE & ME 1
- BME 1000 Biomedical Engineering Orientation 1
- ECE 1001 Introduction to ECE 1

**Basic Science & Mathematics (55 credits)**

- CHEM 1110/1115 General Chemistry I/II 4
- CHEM 1120/1125 General Chemistry II/II 4
- BIOL 1240/1245 Principles of Biology I/II 4
- BIOL 1260/1265 Principles of Biology II/II 4
- MATH 1510 Calculus I 4
- MATH 1520 Calculus II 4
- MATH 2530 Calculus III 4
- MATH 3550 Differential Equations I 3
- MATH 3270 Advanced Mathematics for Engineers 3
- MATH 3240 Numerical Analysis 3
- MATH 3850 Foundations of Statistics 3
- PHYS 1610/1620 Engineering Physics I/II 4
- PHYS 1630/1640 Engineering Physics II/II 4
- PHYS 2610/2620 Modern Physics/Lab 4
- PHYS 4610 Quantum Mechanics 3

**Engineering Mechanics (6 credits)**

- BME 3200 Mechanics 3
- BME 4200 Biomechanics 3
- ESCI 2100 Statics 3
- ESCI 2150 Dynamics 3

**Computation (3 credits)**

- BME 2000 Biomedical Engineering Computing 3
- CSCI 1060 Intro to CS: Scientific Programming 3

**Thermodynamics (3 credits)**

- PHYS 3410 Thermodynamics & Statistical Mechanics 3
- ESCI 2300 Thermodynamics 3

**Electricity & Magnetism (7 credits)**

- PHYS 4210 Electricity & Magnetism I 3
- And one of the following options:
  - ECE 2001/2002 Intro. to ECE/Lab 4
  - PHYS 3510 Analog & Digital Electronics/Lab 4

**Optics (4 credits)**

- PHYS 3310/3320 Optics/Lab 4

**Track Requirements (6 credits)**

Choose one of the following tracks:

**Materials Science**

- BME 3400 Materials Science 3
- ESCI 3100 Mechanics of Solids 3

**Transport/Fluids**

- BME 3300 Transport Fundamentals 3
- ESCI 3200 Fluid Dynamics 3

**Signals/Systems**

- BME 3100 Signals 3
- ECE 3150 Linear Systems 3

**Engineering Depth**

**Focus Area (9 credits)**

- Three Upper Division Engineering Courses 9

**Engineering Physics Electives (6 credits)**

- PHYS 3120 Advanced Classical Mechanics 3
- PHYS 4010 Nanoscience and Nanofabrication Frontiers 3
- PHYS 4020 Experimental Physics 3
- PHYS 4220 Electricity & Magnetism II 3
- PHYS 4620 Application of Quantum Mechanics 3

**Senior Design Project (6 credits)**

- AENG 4004 Flight Vehicle Analysis & Design I 3
- AENG 4014 Flight Vehicle Analysis & Design II 3

**College Core (22 credits)**

- ENGL 1900 Adv. Rhet. & Research or 1920 Adv. Writing 3
- CMM 2200 Small Group Presentation 1
- THEO 1000 Theological Foundations 3
- PHIL 2050 Ethics 3
- PHIL 3400 Ethics & Engineering 3
- Social/Behavioral Science Elective 3
- Humanities Elective 3
- Cultural Diversity Elective 3
Cultural Diversity, Humanities, and Social/Behavioral Science elective courses must be selected from an approved list. See the Parks College introduction in this catalog for more information.

**TOTAL CREDITS: 128**

**Aerospace Engineering Electives Concentration**

Professional Orientation (1 credit)
- PHYS 1110 Introduction to Physics 1
- AENG 1001 Introduction to AE 1

Basic Science & Mathematics (43 credits)
- CHEM 1110/1115 General Chemistry I/Lab 4
- MATH 1510 Calculus I 4
- MATH 1520 Calculus II 4
- MATH 2530 Calculus III 4
- MATH 3550 Differential Equations 3
- MATH 3270 Advanced Mathematics for Engineers 3
- MATH 3240 Numerical Analysis 3
- MATH 3850 Foundations of Statistics 3
- PHYS 1610/1620 Engineering Physics I/Lab 4
- PHYS 1630/1640 Engineering Physics II/Lab 4
- PHYS 2610/2620 Modern Physics/Lab 4
- PHYS 4610 Quantum Mechanics 3

Engineering Physics & Engineering Topics (31 credits)
- AENG 1002 Computer-Aided Engineering Design 1
- CSCI 1060 Scientific Programming 3
- ESCI 2100 Statics 3
- ESCI 2150 Dynamics 3
- ESCI 2300 Thermodynamics 3
- ESCI 3200/3201 Fluid Dynamics/Lab 4
- ESCI 3110 Linear Vibrations 3
- PHYS 3310/3320 Optics/Lab 4
- PHYS 3510 Analog & Digital Electronics/Lab 4
- PHYS 4210 Electricity & Magnetism I 3

Engineering Physics Electives (6 credits)
- PHYS 3120 Advanced Classical Mechanics 3
- PHYS 4010 Nanoscience and Nanofabrication Frontiers 3
- PHYS 4020 Experimental Physics 3
- PHYS 4220 Electricity & Magnetism II 3
- PHYS 4620 Application of Quantum Mechanics 3

Track Requirements (15 credits)
Choose one of the following tracks:

**Aeronautics**
- AENG 2000 Intro. to Aeronautics & Astronautics 3
- AENG 3000 Performance 3
- AENG 4400 Stability & Control 3
- Two Upper Division Courses (AENG/ESCI 3xxx, 4xxx) 6

**Astronautics**
- AENG 2000 Intro. to Aeronautics and Astronautics 3
- AENG 3150 Astrodynamics 3
- AENG 4150 Orbital Mechanics 3
- Two Upper Division Courses (AENG/ESCI 3xxx, 4xxx) 6

**Senior Design Project (6 credits)**
- AENG 4004 Flight Vehicle Analysis & Design I 3
- AENG 4014 Flight Vehicle Analysis & Design II 3

**College Core (22 credits)**
- ENGL 1900 Adv. Rhet. & Research or 1920 Adv. Writing 3
- CMM 2200 Small Group Presentation 1
- THEO 1000 Theological Foundations 3
- PHIL 2050 Ethics 3
- PHIL 3400 Ethics & Engineering 3
- Social/Behavioral Science Elective 3
- Humanities Elective 3
- Cultural Diversity Elective 3

Cultural Diversity, Humanities, and Social/Behavioral Science elective courses must be selected from an approved list. See the Parks College introduction in this catalog for more information.

Open Elective (3 credits)

**TOTAL CREDITS: 127**

**Biomedical Engineering Concentration**

Professional Orientation (1 credit)
- PHYS 1110 Introduction to Physics 1
- BME 1000 Biomedical Engineering Orientation 1

Basic Science & Mathematics (58 credits)
- CHEM 1110/1115 General Chemistry I/Lab 4
- CHEM 1120/1125 General Chemistry II/Lab 4
- BIOL 1240/1245 Principles of Biology I/Lab 4
- BIOL 1260/1265 Principles of Biology II/Lab 4
- BIOL 2600 Human Physiology 3
- MATH 1510 Calculus I 4
- MATH 1520 Calculus II 4
- MATH 2530 Calculus III 4
- MATH 3550 Differential Equations 3
- MATH 3270 Advanced Mathematics for Engineers 3
- MATH 3240 Numerical Analysis 3
- MATH 3850 Foundations of Statistics 3
- PHYS 1610/1620 Engineering Physics I/Lab 4
- PHYS 1630/1640 Engineering Physics II/Lab 4
- PHYS 2610/2620 Modern Physics/Lab 4
- PHYS 4610 Quantum Mechanics 3

Engineering Physics & Engineering Topics (24 credits)
- BME 1010 Biomedical Engineering Introduction 1
- BME 2000 Biomedical Engineering Computing 3
- BME 3200 Mechanics 3
- BME 4200 Biomechanics 3
- PHYS 3410 Thermodynamics & Statistical Mechanics 3
- ECE 2001/2002 Intro. to Electrical Engineering/Lab 4
- PHYS 3310/3320 Optics/Lab 4
- PHYS 4210 Electricity & Magnetism I 3

Engineering Physics Electives (6 credits)
- BME 1000 Biomedical Engineering Introduction 1
- PHYS 4010 Nanoscience and Nanofabrication Frontiers 3
- PHYS 4020 Experimental Physics 3
- PHYS 4220 Electricity & Magnetism II 3
- PHYS 4620 Application of Quantum Mechanics 3

Track Requirements (12 credits)
Choose two of the following tracks:

**Transport**
- BME 3300 Transport Fundamentals 3
- BME 4300 Biotransport 3

**Materials Science**
- BME 3400 Materials Science 3
BME 4400 Biomaterials

**Measurements**

BME 3050 Measurements
And one of the following two courses:
BME 3150 Biomedical Instrumentation
BME 4600 Quantitative Physiology I

**Signals & Systems**

BME 3100 Signals
BME 4100 Biomedical Signals

**Senior Design Project**

BME 4950 Senior Project I
BME 4960 Senior Project II

**Senior Design Project (6 credits)**

AENG 4004 Flight Vehicle Analysis & Design I
AENG 4014 Flight Vehicle Analysis & Design II

**College Core (22 credits)**

ENGL 1900 Adv. Rhet. & Research or 1920 Adv. Writing
CMM 2200 Small Group Presentation
THEO 1000 Theological Foundations
PHIL 2050 Ethics
PHIL 3400 Ethics & Engineering
Social/Behavioral Science Elective
Humanities Elective
Cultural Diversity Elective
Cultural Diversity, Humanities, and
Social/Behavioral Science elective courses must be
selected from an approved list. See the Parks
College introduction in this catalog for more
information.

**TOTAL CREDITS: 129**

**Computer Engineering Concentration**

**Professional Orientation (1 credit)**

PHYS 1110 Introduction to Physics
ECE 1001 Introduction to ECE

**Basic Science & Mathematics (46 credits)**

CHEM1110/1115 General Chemistry I/Lab
MATH 1510 Calculus I
MATH 1520 Calculus II
MATH 2530 Calculus III
MATH 3550 Differential Equations
MATH 3270 Advanced Mathematics for Engineers
MATH 3240 Numerical Analysis
MATH 3850 Foundations of Statistics
PHYS 1610/1620 Engineering Physics I/Lab
PHYS 1630/1640 Engineering Physics II/Lab
PHYS 2610/2620 Modern Physics/Lab
PHYS 3110 Classical Mechanics
PHYS 4610 Quantum Mechanics

**Engineering Physics & Engineering Topics (41 credits)**

CSCI 1060 Intro. to CS: Scientific Programming
ECE 2101 Engineering Circuits I
ECE 2102 Engineering Circuits II
ECE 2103 Electrical Science Lab
ECE 2205/2206 Digital Design/Lab
ECE 3130 Semiconductor Devices
ECE 3140 Electromagnetic Fields
ECE 3215/3216 Computer Systems Design/Lab
ECE 3225/3226 Microprocessors/Lab

Two Engineering Electives selected with Faculty Mentor
PHYS 3310/3320 Optics/Lab
PHYS 3410 Thermodynamics & Statistical Mechanics

**Engineering Physics Electives (6 credits)**

PHYS 3120 Advanced Classical Mechanics
PHYS 4010 Nanoscience and Nanofabrication Frontiers
PHYS 4020 Experimental Physics
PHYS 4220 Electricity & Magnetism II
PHYS 4620 Application of Quantum Mechanics

**Senior Design Project (6 credits)**

ECE 4800 ECE Design I
ECE 4810 ECE Design II

**College Core (22 credits)**

ENGL 1900 Adv. Rhet. & Research or 1920 Adv. Writing
CMM 2200 Small Group Presentation
THEO 1000 Theological Foundations
PHIL 2050 Ethics
PHIL 3400 Ethics & Engineering
Social/Behavioral Science Elective
Humanities Elective
Cultural Diversity Elective
Cultural Diversity, Humanities, and
Social/Behavioral Science elective courses must be
selected from an approved list. See the Parks
College introduction in this catalog for more
information.

**Open Electives (6 credits)**

**TOTAL CREDITS: 128**

**Electrical Engineering Concentration**

**Professional Orientation (1 credit)**

PHYS 1110 Introduction to Physics
ECE 1001 Introduction to ECE

**Basic Science & Mathematics (46 credits)**

CHEM1110/1115 General Chemistry I/Lab
MATH 1510 Calculus I
MATH 1520 Calculus II
MATH 2530 Calculus III
MATH 3550 Differential Equations
MATH 3270 Advanced Mathematics for Engineers
MATH 3240 Numerical Analysis
MATH 3850 Foundations of Statistics
PHYS 1610/1620 Engineering Physics I/Lab
PHYS 1630/1640 Engineering Physics II/Lab
PHYS 2610/2620 Modern Physics/Lab
PHYS 3110 Classical Mechanics
PHYS 4610 Quantum Mechanics

**Engineering Physics & Engineering Topics (23 credits)**

CSCI 1060 Intro. to CS: Scientific Programming
ECE 2101 Engineering Circuits I
ECE 2102 Engineering Circuits II
ECE 2103 Electrical Science Lab
ECE 3130 Semiconductor Devices
ECE 3140 Electromagnetic Fields
PHYS 3310/3320 Optics/Lab
PHYS 3410 Thermodynamics & Statistical Mechanics

**Engineering Physics Electives (6 credits)**

PHYS 3120 Advanced Classical Mechanics
PHYS 4010 Nanoscience and Nanofabrication Frontiers
PHYS 4020 Experimental Physics 3
PHYS 4220 Electricity & Magnetism II 3
PHYS 4620 Application of Quantum Mechanics 3

**Track Requirements (15-16 credits)**

Choose one of the following tracks:

**Electromagnetic Fields and Waves**
ECE 3110 Electric Energy Conversion 3
ECE 4160 Communication Systems 3
ECE 4140 Electromagnetic Waves 3
Two Engineering Electives selected with advisor 6

**Analog Electronics**
ECE 3150 Linear Systems 3
ECE 3131/3132 Electronic Circuit Design/Lab 4
ECE 4120 Automatic Control Systems 3
Two Engineering Electives selected with mentor 6

**Communications**
ECE 2205/2206 Digital Design/Lab 4
ECE 3150 Linear Systems 3
ECE 4160 Communication Systems 3
Two Engineering Electives selected with mentor 6

**Senior Design Project (6 credits)**
ECE 4800 ECE Design I 3
ECE 4810 ECE Design II 3

**College Core (22 credits)**
ENGL 1900 Adv. Rhet. & Research or 1920 Adv. Writing 3
CMM 2200 Small Group Presentation 1
THEO 1000 Theological Foundations 3
PHIL 2050 Ethics 3
PHIL 3400 Ethics & Engineering 3
Social/Behavioral Science Elective 3
Humanities Elective 3
Cultural Diversity Elective 3
Cultural Diversity, Humanities, and Social/Behavioral Science elective courses must be selected from an approved list. See the Parks College introduction in this catalog for more information.

**Open Electives (6 credits)**

**TOTAL CREDITS: 125-126**

**Mechanical Engineering Concentration**

**Professional Orientation (1 credit)**
PHYS 1110 Introduction to Physics 1
ECE 1001 Introduction to ECE 1

**Basic Science & Mathematics (43 credits)**
CHEM 1110/1115 General Chemistry I/Lab 4
MATH 1510 Calculus I 4
MATH 1520 Calculus II 4
MATH 2530 Calculus III 4
MATH 3550 Differential Equations 3
MATH 3270 Advanced Mathematics for Scientists 3
MATH 3240 Numerical Analysis 3
MATH 3850 Foundations of Statistics 3
PHYS 1610/1620 Engineering Physics I/Lab 4
PHYS 1630/1640 Engineering Physics II/Lab 4
PHYS 2610/2620 Modern Physics/Lab 4
PHYS 4610 Quantum Mechanics 3

**Engineering Physics & Engineering Topics (47 credits)**
AENG 3100 Computer Aided Engineering Design 3
CSCI 1060 Intro.to CS: Scientific Programming 3
MENG 1002 Computer-Aided Engineering Design 1
ESCI 2100 Statics 3
ESCI 2150 Dynamics 3
ESCI 2300 Thermodynamics 3
ESCI 3100/3101 Mechanics of Solids/Lab 4
ESCI 3200/3201 Fluid Dynamics/Lab 4
ESCI 3110 Linear Vibrations 3
MENG 2000 Foundations of Engineering Design 3
MENG 3010 Machine Design 3
Upper Div. Engineering Course (MENG/ESCI 3xxx, 4xxx) 3
PHYS 3310/3320 Optics/Lab 4
PHYS 3510 Analog & Digital Electronics/Lab 4
PHYS 4210 Electricity & Magnetism I 3

**Engineering Physics Electives (6 credits)**
PHYS 3120 Advanced Classical Mechanics 3
PHYS 4010 Nanoscience and Nanofabrication Frontiers 3
PHYS 4020 Experimental Physics 3
PHYS 4220 Electricity & Magnetism II 3
PHYS 4620 Application of Quantum Mechanics 3

**Senior Design Project (6 credits)**
ECE 4800 ECE Design I 3
ECE 4810 ECE Design II 3

**College Core (22 credits)**
ENGL 1900 Adv. Rhet. & Research or 1920 Adv. Writing 3
CMM 2200 Small Group Presentation 1
THEO 1000 Theological Foundations 3
PHIL 2050 Ethics 3
PHIL 3400 Ethics & Engineering 3
Social/Behavioral Science Elective 3
Humanities Elective 3
Cultural Diversity Elective 3
Cultural Diversity, Humanities, and Social/Behavioral Science elective courses must be selected from an approved list. See the Parks College introduction in this catalog for more information.

**Open Electives (3 credits)**

**TOTAL CREDITS: 128**

**Continuation Standards**
Students must have a GPA of 2.0 in Engineering Physics major/minor coursework to be retained in the major.

**MINOR IN PHYSICS**

**Program Requirements (Arts & Science)**

**Required Courses (12 credits)**
PHYS 1610/1620 Engineering Physics I/Lab 4
PHYS 1630/1640 Engineering Physics II/Lab 4
PHYS 2610/2620 Modern Physics/Lab 4

**Elective Courses (6 credits)**
PHYS 3000–PHYS 4930 6

**TOTAL CREDITS: 18**
Program Requirements (Parks)

Required Courses (12 credits)
PHYS 1610/1620 Engineering Physics I/Lab 4
PHYS 1630/1640 Engineering Physics II/Lab 4
PHYS 2610/2620 Modern Physics/Lab 4

Elective Courses (10 credits)
Three physics courses (one with lab) numbered
PHYS 3000 – PHYS 4930 10

TOTAL CREDITS: 22

Continuation Standards
Students must have a GPA of 2.0 in Physics minor coursework to be retained in the minor.
GRADUATE ENGINEERING

LEADERSHIP
Riyadh Hindi, Ph.D., P.Eng., F. SEI
Associate Dean for Graduate Education & Research

OVERVIEW
The graduate program in engineering at Saint Louis University’s Parks College of Engineering, Aviation and Technology provides students with the depth of knowledge necessary to pursue advanced academic or industrial work in a modern, ever-changing world. Students learn enhanced analytical skills through an in-depth understanding of major theoretical and practical concepts, written and oral communication skills as applied to technical areas, and the critical and creative thinking skills required to conduct state-of-the-art research.

Parks College offers several graduate engineering programs:
+ Aerospace & Mechanical engineering
+ Biomedical engineering
+ Civil engineering
+ Electrical & Computer engineering (M.S. Non-Thesis only)
+ Engineering physics (M.S. only)

POLICIES
Students are required to enroll each semester until degree is received. M.S. students should satisfy two semesters of Graduate Seminar beyond a bachelor’s degree.

Up to 12 credits may be transferred from another institution.

Independent Studies and Special Topics Course
Independent Study courses are reserved for specialized topics individual to a graduate student that the student and advisor both agree fits into the program of study. Like Independent Study courses, Special Topics courses are not regularly offered courses in the catalog. Special Topics courses, however, are not specially written to match a student’s research interests, but rather a course the department offers to a limited number of students for one semester. Since both types of courses are not in the catalog, the Graduate Education office requires a copy of the outline or syllabus will be kept in the student’s file. All independent studies and special topics courses must be submitted and approved by the mentor/advisor of students prior to registration.

Faculty
Craig Adams, Ph.D.
Theodosios Alexander, Sc.D.
Gary Bledsoe, Ph.D.
Larry Boyer
Chris Carroll, Ph.D.
Sridhar Condoor, Ph.D.
Amanda Cox, Ph.D., PE
William Ebel, Ph.D.
Yan Gai, Ph.D.
Koyal Garg, Ph.D.
Roobik Gharabagi, Ph.D.
Jenna Gorlewicz, Ph.D.
Srikanth Gururajan, Ph.D.
Andrew Hall, Ph.D.
Riyadh Hindi, Ph.D., PE
Sanjay Jayaram, Ph.D.
Jalil Kianfar, Ph.D.
Armineh Khalili
Ray LaBeau, Ph.D.
Ronaldo Luna, Ph.D., PE
Jeff Ma, Ph.D.
Huliyar Mallikarjuna, Ph.D.
Mark McQuilling, Ph.D.
Kyle Mitchell, Ph.D.
Habib Rahman, Ph.D.
K. Ravindra, Ph.D.
Michelle Sabick, Ph.D.
Michael Swartwout, Ph.D.
Silviya Zustiak, Ph.D.

ACCELERATED BACHELORS TO MASTERS

Continuation Standards
Students must maintain a cumulative GPA of 3.00 in all required graduate/professional courses.

MASTER OF SCIENCE IN ENGINEERING

Program Highlights
Graduate students in Engineering at Parks College of Engineering, Aviation and Technology will demonstrate: 1) enhanced professional and analytical skills through the development of an in-depth understanding of theoretical and practical concepts; 2) excellent communications skills through written and oral presentations; 3) creative thinking skills through mastery of topics required to solve complex engineering problems; and 4)
depth of knowledge required to pursue advanced work in a modern, ever-changing world through entrepreneurial experiences woven into their program.

These attributes will be assessed during the required examination milestones. For a Master of Science (M.S.) degree, the required milestone is a written research report/thesis and corresponding oral defense presentation. The M.S. course only option can be assessed through a portfolio process by the housing department.

**Curriculum Overview**
The master’s degree in engineering requires a minimum of 30 credits beyond a bachelor’s degree. If students pursue an option in research, six of the total credits to the degree must be in thesis research. If students pursue the project option, three of the total credits for the degree must be devoted to carrying out a project, approved by a faculty adviser.

The engineering M.S. also allows students to customize a program of study to meet professional goals. This program, which will also take into account the academic background of students, must be approved by a faculty adviser, the department chair and the associate dean for graduate education at Parks College.

There are five concentrations in the engineering master’s program:

+ Aerospace and mechanical engineering
+ Biomedical engineering
+ Civil engineering
+ Electrical and computer engineering
+ Engineering physics

**Fieldwork and Research Opportunities**
The expert faculty of Parks College collaborate with graduate students in ground-breaking research in the following areas:

+ Aircraft engine aerodynamics
+ Cardiovascular and assist devices
+ Energy, sustainability and environmental
+ Engineering education
+ Flight control systems
+ Haptic and human-machine interfaces
+ Human factors/physiology
+ Innovation and entrepreneurship
+ Medical robotics
+ Orthopedic biomechanics
+ Regenerative medicine
+ Robotics and mechatronics
+ Safety

+ Sensors and systems
+ Signal processing
+ Space systems
+ Structures and bridges
+ Thermal-fluid sciences
+ Tissue engineering
+ Transportation
+ Unmanned aerial systems
+ Water resources and hydraulics

**Careers**
Graduates are prepared to enter the aerospace and mechanical engineering, biomedical engineering, civil engineering, electrical and computer engineering, or engineering physics industry, depending upon their chosen concentration.

**Admission Requirements**
Most admitted students meet the following criteria:

- GRE quantitative score greater than 650 (old grading system) or greater than 150 (new grading system)
- Undergraduate GPA of at least 3.0

A four-year undergraduate degree in engineering related field of desired graduate program.

**Application Requirements**

+ Application form and fee
+ Transcript(s) from all colleges and universities attended
+ Three letters of recommendation (preferably from recent instructors)
+ GRE scores
+ Résumé or curriculum vitae
+ Professional goal statement

**Requirements for International Students**

+ A completed Declaration of Financial Support packet with all accompanying documents
+ TOEFL or PTE Academic score
+ Check the English Proficiency Policy page for specific TOEFL and PTE score requirements. Students may also visit the international prospects, applicants and students page for more information about international application requirements.
+ INTO Saint Louis University offers the Pathway Program for international students who are interested this course but do not meet the direct entry requirements. Visit intostudy.com/slu/programs for more information.
Assistantship Application Deadline
Admitted students who want to be considered for an assistantship must submit a separate application for assistantship consideration by March 1.

Review Process
Once all the materials are received and the online application is complete, materials will be reviewed by the Parks College's Office of Graduate Education and Research before being sent to the engineering department for a recommendation. The final decision is made by the Parks College Associate Dean of Graduate Education and Research.

Admissions decisions are made based on the background and educational experience of students. Applications are reviewed when completed, and decisions are generally made within a few weeks.

Scholarships and Financial Aid
Parks College offers graduate fellowship awards and assistantships each year. Assistantships provide tuition, stipend and health insurance. There are also many opportunities for students to receive funding through external research grants that are managed by individual faculty.

For more information, visit the student financial services office online at finaid.slu.edu.

Program Requirements
Students choose one of three options for their Master of Science

+ course only
+ project option
+ thesis option

For students pursuing the research option, 6 of the total credits to the degree must be in Thesis Research. For students pursuing the project option, 3 of the total credits to the degree must be devoted to carrying out a project, approved by students’ Faculty Advisor.

M.S. students prepare a program of study that must be approved by the Faculty Advisor, department chair, and the Parks College Graduate Programs Director. This program of study is developed within the context of background and career goals of students allowing them to customize their program to suit their professional goals.

Non-Course Requirements
Thesis option

First Semester in the M.S. Program
In the first semester, M.S. students will begin taking courses as indicated in the program of study. In parallel, students may also begin research in an identified research area, under the guidance of a Faculty Advisor.

The Faculty Advisor and student will form a Guidance Committee of at least three members. The Committee members should be persons who will likely provide expertise and guidance that will assist students in research. At least one member, besides the Faculty Advisor, must be in the home department of students. If the Faculty Advisor is in another department, then one Guidance Committee member in the home department will be designated as the Guidance Committee Chair.

Thesis Proposal
Students prepare a Thesis Proposal before the end of the first-year activities. The title and outline for this proposal are approved by the Guidance Committee and reported on the Master’s Thesis Proposal/Prospectus form. After completing the thesis proposal, students meet with the Guidance Committee at least once every semester.

Thesis Defense
An oral Thesis Defense must be completed before graduation. The Defense typically includes a seminar that is open to the public. Following the open session, the student and Guidance Committee continue discussion in a closed session. A written Thesis report is submitted ~4 weeks prior to the oral defense.

Based on the Defense, the Guidance Committee may:
+ Approve the Thesis,
+ Conditionally approve, with specific instructions on revisions to the Thesis document, or
+ Not approve the Thesis.

The Guidance Committee conveys the decision to the Department Chair and the Director of Graduate Programs.

Continuation Standards
Students are expected to maintain a cumulative grade point average (GPA) of 3.00; lower GPA may result in probationary status and/or dismissal from the program due to unsatisfactory academic performance.
DOCTOR OF PHILOSOPHY IN ENGINEERING

Program Highlights
The Doctor of Philosophy (Ph.D.) programs focus on a specific research topic. The students are expected to conduct original academic research that culminates in a dissertation and peer-reviewed publications. Additional coursework related to the chosen research area is also required.

Ph.D. students prepare a program of study that must be approved by the Faculty Advisor, Department Chair, and the Director of Graduate Programs. This program of study is developed and then reviewed within the context of students’ background and career goals, allowing students to customize their program to suit their professional goals.

Graduate students in Engineering at Parks College of Engineering, Aviation and Technology will demonstrate: 1) enhanced professional and analytical skills through the development of an in-depth understanding of theoretical and practical concepts; 2) excellent communications skill through written and oral presentations; 3) creative thinking skills through mastery of topics required to solve complex engineering problems; and 4) depth of knowledge required to pursue advanced work in a modern, ever-changing world through entrepreneurial experiences woven into their program.

These attributes will be assessed during the required examination milestones. For a Ph.D. degree, the required milestones include a qualifying exam, a written dissertation proposal and corresponding oral defense, and a written dissertation and corresponding oral defense presentation.

Curriculum Overview
The Ph.D. in engineering requires a total of 60 credits of coursework beyond the bachelor’s degree, with a minimum of 12 credits of dissertation. A limited number of courses may be at the 4000 level; all others must be at the 5000 or higher level. Those students who earn an M.S. degree may include a maximum of 24 master’s degree course credits with departmental approval, but not the thesis or project credits in the 60 credits for the Ph.D. degree.

There are four concentrations in the engineering doctoral program:

+ Aerospace and mechanical engineering
+ Biomedical engineering
+ Civil engineering
+ Electrical and computer engineering

Fieldwork and Research Opportunities
The expert faculty of Parks College collaborate with graduate students in ground-breaking research in the following areas:

+ Aircraft engine aerodynamics
+ Cardiovascular and assist devices
+ Energy, sustainability and environmental
+ Engineering education
+ Flight control systems
+ Haptic and human-machine interfaces
+ Human factors/physiology
+ Innovation and entrepreneurship
+ Medical robotics
+ Orthopedic biomechanics
+ Regenerative medicine
+ Robotics and mechatronics
+ Safety
+ Sensors and systems
+ Signal processing
+ Space systems
+ Structures and bridges
+ Thermal-fluid sciences
+ Tissue engineering
+ Transportation
+ Unmanned aerial systems
+ Water resources and hydraulics

Careers
Graduates of the doctoral program seek employment in the industry, government or as university professors.

Admission Requirements
Most admitted students meet the following criteria:

GRE quantitative score greater than 650 (old grading system) or greater than 150 (new grading system)
Undergraduate GPA of at least 3.0
A four-year undergraduate degree in engineering related field of desired graduate program.

Application Requirements
+ Application form and fee
+ Transcript(s) from all colleges and universities attended
+ Three letters of recommendation (preferably from recent instructors)
+ GRE scores
+ Résumé or curriculum vitae
+ Professional goal statement

Requirements for International Students
+ A completed Declaration of Financial Support packet with all accompanying documents
+ TOEFL or PTE Academic score
+ Check the English Proficiency Policy page for specific TOEFL and PTE score requirements. Students may also visit the international prospects, applicants and students page for more information about international application requirements.
+ INTO Saint Louis University offers the Pathway Program for international students who are interested this course but do not meet the direct entry requirements. Visit intostudy.com/slu/programs for more information.

Assistantship Application Deadline
Admitted students who want to be considered for an assistantship must submit a separate application for assistantship consideration by March 1.

Review Process
Once all the materials are received and the online application is complete, materials will be reviewed by the Parks College's Office of Graduate Education and Research before being sent to the engineering department for a recommendation. The final decision is made by the Parks College Associate Dean of Graduate Education and Research.

Admissions decisions are made based on the background and educational experience of students. Applications are reviewed when completed, and decisions are generally made within a few weeks.

Scholarships and Financial Aid
Parks College offers graduate fellowship awards and assistantships each year. Assistantships provide tuition, stipend and health insurance. There are also many opportunities for students to receive funding through external research grants that are managed by individual faculty.

For more information, visit the student financial services office online at finaid.slu.edu.

Program Requirements
The Engineering Ph.D. degree requires a total of 60 credits beyond the bachelor’s degree with a minimum of 12 credits of dissertation research. Of the 60 credits, a maximum of 9 credits may be comprised of coursework at the 4000-level; all other course credits must be at the 5000 or 6000-level. Those students who earn a Master of Science degree may include up to 24 credits from the associated Master of Science degree, but not the thesis or project credits, in the 60 credits which are needed for the Ph.D. degree. Ph.D. students should also satisfy four semesters of Graduate Seminar beyond a bachelor’s degree.

Non-Course Requirements
First Semester in Ph.D. Program
In the first semester, Ph.D. students will begin taking courses as indicated in the program of study. In parallel, students may also begin research in an identified research area under the guidance of a Faculty Advisor.

The Faculty Advisor and students will form a Guidance Committee of at least five members. The Committee members should be persons who will likely provide expertise and guidance that will assist students in their research. At least two members, besides the Faculty Advisor, must be in students’ home department. If the Faculty Advisor is in another department, then one Guidance Committee member in the home department will be designated as the Guidance Committee Chair.

Annual Student Review
All active students are expected to check in with their Faculty Advisor regularly regarding coursework and research, and to conduct an Annual Student Review. New students who start in the Summer and Fall semesters will conduct their Reviews by the end of January, and every academic year thereafter by the end of May. New students who start in the Spring semester will conduct their Reviews by the end of May. All students conduct their reviews annually in consultation with the Faculty Advisor and submitted to a respective Department Chair and then the Graduate Education office by the end of May.

The Annual Student Review form can be obtained from the Parks College Graduate Programs Office.

Qualifying Exam
A qualifying exam will be administered according to the expectations of the academic discipline. For example, in engineering a qualifying exam may be administered relatively early in the doctoral studies. In aviation, the qualifying exam is structured to assess comprehensive knowledge of
the discipline after all or nearly all of academic work has been completed and thus, it is administered closer to the completion of the degree.

The student’s Guidance Committee will advise students on preparation for the Qualifying Exam. Ideally, the Guidance Committee will continue after the Qualifying Exam and through the dissertation research.

The Qualifying Exam is designed to determine if students are prepared to continue Ph.D. studies. Normally, it is a written exam, with the option for follow-up with an oral exam. The details of the exam are determined by the home department, but all portions of the Qualifying Exam should be completed in one day.

Qualifying examinations are arranged and administered by the home department. The result of the exam may be a pass, no-pass, or conditional-pass. The conditional-pass will normally require that students correct specific weaknesses, with appropriate modifications to the plan of study.

Qualifying exam procedures can be accessed at the Parks College Graduate Education website. Error! Hyperlink reference not valid.

Dissertation Proposal & Doctoral Oral Examination
Typically, after a year following the Qualifying Exam, students will present and defend a Dissertation Proposal, called a Doctoral Oral Examination. This Exam is based on their written proposal, and their oral defense of the proposal. Both components will be evaluated by the Guidance Committee.

Doctoral Candidate status will be given to students after successful passage of the Doctoral Oral Examination of the dissertation proposal.

Dissertation Defense
At a time selected by students and the Guidance Committee, the doctoral candidates present the dissertation research in both written and oral format. The Defense typically includes a seminar that is open to the public. Following the open session, the student defending and his or her Guidance Committee continues the discussion in a closed session.

Based on the Defense, the Guidance Committee may: (1) approve the Dissertation, (2) conditionally approve, with specific instructions on revisions to the Dissertation document, or (3) not approve the Dissertation.

Continuation Standards
Students are expected to maintain a cumulative grade point average (GPA) of 3.00; lower GPA may result in probationary status and/or dismissal from the program due to unsatisfactory academic performance.