DEPARTMENT OF MECHANICAL, AEROSPACE, AND INDUSTRIAL ENGINEERING

The Department of Mechanical, Aerospace, and Industrial Engineering offers two Bachelor of Science degrees in: (1) Industrial and Systems Engineering (ISE) and (2) Mechanical Engineering (ME). The programs are currently accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org (http://www.abet.org/). Individuals enrolling in this degree program are given the opportunity to develop a strong background in Engineering Science and to learn the analysis, design, and synthesis tools necessary to contribute in traditional and emerging areas of technology.

The department has excellent laboratory facilities where students receive hands-on instruction from faculty members. Computer-aided design (CAD) facilities, including state-of-the-art workstations, are routinely used. Some classes are taught by adjunct faculty from local industries, giving students the opportunity to interact with engineering professionals engaged in relevant engineering practice.

Because of the broad engineering training in this program, graduates may find employment in many industries, including companies or government agencies associated with aerospace, automotive, energy, petroleum, manufacturing, biomedical engineering, and research.

Direct Admission Criteria

Applicants entering UTSA as Freshmen or Freshmen Transfers (fewer than 12 transferable semester credit hours) will be directly admitted to the ME program if they:

- meet all UTSA undergraduate admission requirements,
- qualify for enrollment in MAT 1213 Calculus I , or a higher level mathematics course, and
  - are ranked in the top 10 percent of their high school class (no minimum SAT or ACT scores required), *or*
  - are ranked below the top 10 percent of their high school class and have a minimum 1200 SAT or 25 ACT score.

Applicants with SAT scores below 1200 or ACT scores below 25 may undergo admission by committee review.

Transfer requirements for direct admission to the ME program for students who have earned 12 or more transferable semester credit hours:

- meet all UTSA undergraduate transfer admission requirements, and
- have completed MAT 1213 Calculus I and WRC 1013 Freshman Composition I , or the equivalents, with grades of “C-” or better, and
- meet grade point average requirements:
  - applicants with a transfer grade point average of 3.00 or higher may be granted direct admission to the major, or
  - applicants with a transfer grade point average below 3.00 may be granted admission to the College by committee review.

Applicants who do not meet Mechanical Engineering admission requirements will be admitted to the Engineering, Math, and Sciences Studies major in the University College. Students have three semesters to complete Calculus I with a grade of "C-" or better and meet the ME Transfer Requirements.

“C-” Grade Rule

A grade of “C-” or better in any science, engineering, or mathematics course required for an engineering degree or any other course that is a prerequisite to any ME or Engineering (EGR) course indicates satisfactory preparation for further engineering education. Any course assigned a grade below a “C-” must be repeated before enrolling in any course for which it is a prerequisite. This requirement is subject to both the Gateway Course and Three-Attempt Limit rules.

Laptop Program

The laptop program requires that students entering Klesse College programs have their own laptop (notebook) computers and required software. The computer should be upgradeable in order to be of productive use for the duration of the academic program. The laptop specifications may vary per academic program. For further and specific information concerning laptop requirements for each program, please see the Klesse College hardware recommendations website (https://klesse.utsa.edu/student/computer-requirements.html).

- B.S. degree in Industrial and Systems Engineering (p. 1)
- B.S. degree in Mechanical Engineering (p. 5)

Bachelor of Science Degree in Industrial and Systems Engineering

The Bachelor of Science degree in Industrial and Systems Engineering (ISE) at UTSA is designed to prepare students with the fundamental engineering knowledge necessary for successful careers as industrial and systems engineers in manufacturing, service industry, government, military, and various other operations. Graduates of this program will have acquired a solid understanding and important skills in manufacturing systems engineering, operations research, systems modeling, data analytics, quality engineering, and process optimization. Graduates will be prepared with broad coverage of industrial and systems engineering knowledge and equipped with solid capabilities in commanding modern technologies to meet the increased demand in the growth areas of enterprise integration, advanced manufacturing, logistics, automation, and advanced controls.

Program Educational Objectives

The BS-ISE program prepares students to attain the following program educational objectives a few years after graduation:

1. Have engineering or other careers in industry, government, and/or pursue advanced graduate or professional degrees.
2. Apply their engineering knowledge, critical thinking, creativity, and problem-solving skills in professional engineering practice or in non-engineering fields.
3. Continue to advance their knowledge, communication, and leadership skills through graduate education, professional development courses, self-directed study, and/or on-the-job training, and experience.
4. Apply their understanding of societal, environmental, and ethical issues to their professional activities.

Student Outcomes

Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge,

skills, and behaviors that students acquire as they progress through the program. The BS-ISE program has adopted student outcomes (1) through (7) required by Criterion 3 of the ABET–Engineering Accreditation Commission.

The student outcomes for the BS-ISE program at UTSA are:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Core Curriculum Requirements (42 semester credit hours)

Students seeking the Bachelor of Science degree in Industrial and Systems Engineering must fulfill the University Core Curriculum requirements in the same manner as other students.

MAT 1213 Calculus I is recommended to fulfill the Core Requirement in Mathematics and it is required to fulfill the General Engineering Requirements.

PHY 1943 Physics for Scientists and Engineers I and PHY 1963 Physics for Scientists and Engineers II are recommended to fulfill the Core Requirement in Life and Physical Sciences and they are required to fulfill the General Engineering Requirements.

EGR 1403 Technical Communication is recommended to fulfill the Core Requirement in the Component Area Option.

ECO 2023 Introductory Microeconomics is recommended to fulfill the Core Requirement in Social and Behavioral Sciences and is required to fulfill the Foundation Course Requirements.

Gateway Courses

Students pursuing the Bachelor of Science degree in Industrial and Systems Engineering must successfully complete each of the following Gateway Courses with a grade of "C-" or better in no more than two attempts. A student who is unable to successfully complete these courses within two attempts, including dropping a course with a grade of "W" or taking an equivalent course at another institution, will be required to change their major.

EGR 2103	Statics
EGR 3423	Differential Equations for Engineers
MAT 1213	Calculus I

Degree Requirements

Students seeking the Bachelor of Science degree in Industrial and Systems Engineering must complete the following semester credit hours, as well as the Core Curriculum requirements and General Engineering requirements:

A. General Engineering Requirements		**25**
CHE 1103	General Chemistry I	
EGR 2302	Linear Algebra for Engineers	
EGR 2313	Multivariable Calculus and Series for Engineers	
EGR 3423	Differential Equations for Engineers	
MAT 1213	Calculus I (core)	
MAT 1223	Calculus II	
PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory (core)	
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory (core)	
B. Foundation Courses		**15**
ECO 2023	Introductory Microeconomics (core and major)	
EE 2213	Electric Circuits and Electronics	
EGR 2103	Statics	
EGR 3713	Engineering Economic Analysis	
STA 2303	Applied Probability and Statistics for Engineers	
C. Industrial and Systems Engineering Courses		**49**
ISE 3513	Inferential Statistics for Industrial Engineers *	
ISE 3653	Operations Research I *	
ISE 4273	Systems Modeling and Simulation *	
ISE 4503	Lean Manufacturing and Enterprise Engineering *	
ISE 4573	Facilities Planning and Design *	
ISE 4583	Quality Engineering and Six Sigma *	
ISE 4653	Operations Research II *	
ISE 4713	Human Factors Engineering and Ergonomics *	
ISE 4723	Reliability in Engineering Design *	
ISE 4763	Integrated Production Systems *	
ISE 4813	Senior Design I *	
ISE 4823	Senior Design II *	
ME 1403	Engineering Practice and Graphics	
ME 3173	Numerical Methods	
ME 3243 & ME 3241	Materials Engineering and Materials Engineering Laboratory	
ME 3263	Manufacturing Engineering	
D. Technical Electives		**9**

Students must select 9 credits of ISE Technical Electives from the courses below.		
ISE 4263	Supply Chain Engineering *	
ISE 4363	Data Analytics in Industrial Systems *	
ISE 4373	Cyber-informed Engineering *	
ISE 4563	Computer Integrated Manufacturing *	
ISE 4911	Independent Study *	
ISE 4913	Independent Study *	
ISE 4953	Special Studies in Industrial and Systems Engineering *	
Total Credit Hours		**98**

*New ISE Courses

ISE 3513. Inferential Statistics for Industrial Engineers. (3-0) 3 Credit Hours.
Prerequisite: STA 2303. Statistical concepts and methods with practical applications to industrial engineering problems. Topics include descriptive and inferential statistics, simple and multiple linear regression models, hypothesis testing, analysis of variance (ANOVA), and fundamentals of design of experiments. Generally offered: Fall. This course has Differential Tuition. Course Fee: DL01 $75.

ISE 3653. Operations Research I. (3-0) 3 Credit Hours.
Prerequisite: EGR 2302, and STA 2303 or ME 3113. Introduction to fundamental optimization models and solution methods, including linear programs, the simplex method, duality theory, sensitivity analysis, integer programs, and network flows. Focus on formulating and solving practical operations research problems and the use of optimization software. (Same as ME 3273. Credit cannot be earned for both ME 3273 and ISE 3653.) Generally offered: Fall. This course has Differential Tuition.

ISE 4263. Supply Chain Engineering. (3-0) 3 Credit Hours.
Prerequisite: ISE 3653* or equivalent. This course focuses on the engineering design and the use of operations research to make optimal supply chain decisions. Students will learn essential concepts and solution methods to address supply chain problems related to design, control, operations, and management with applications in facility location, capacity determination, logistics, contract management, inventory control, and sustainability. Generally offered: Fall. This course has Differential Tuition.

ISE 4273. Systems Modeling and Simulation. (3-0) 3 Credit Hours.
Prerequisite: ME 3173, and ME 3113 or ISE 3513*, or equivalents. Systems analysis approach to formulating and solving engineering problems. Topics include mathematical modeling, discrete event simulation, and decision analysis. Focus on applying systems modeling methods on practical industrial problems and the use of simulation software. (Formerly ME 4273 and ISE 4213. Credit cannot be earned for both ISE 4213 and ME 4273 and ISE 4273.) Generally offered: Spring. This course has Differential Tuition.

ISE 4363. Data Analytics in Industrial Systems. (3-0) 3 Credit Hours.
Prerequisite: ISE 3653* or equivalent. Introduction to discovery and communication of meaningful patterns in data with emphasis on industrial systems. Topics include data description (descriptive/visualization techniques), prediction (predictive modeling using machine learning), improve performance (optimization/decision making). Generally offered: Fall. This course has Differential Tuition.

ISE 4373. Cyber-informed Engineering. (3-0) 3 Credit Hours.
Prerequisite: ME 3173. Introduction to cyber-informed engineering principles, integrating cybersecurity considerations into the design, operation, and protection of industrial and critical infrastructure systems. Topics include cyber-physical system vulnerabilities, attack surfaces, resilience engineering, and regulatory frameworks. Through case studies and hands-on exercises, students will develop a foundational understanding of how to incorporate cybersecurity into engineering decision-making and system design. This course has Differential Tuition.

ISE 4503. Lean Manufacturing and Enterprise Engineering. (3-0) 3 Credit Hours.
Prerequisite: ME 3263 or equivalent. Concepts and applications of Lean Systems applied to manufacturing and non-manufacturing environments. Topics include lean fundamentals and various tools and methodologies for transformation of companies and organizations into globally competitive enterprises. Team project on Value Streaming Mapping analysis of processes in real settings is required. (Same as ME 4503. Credit cannot be earned for both ME 4503 and ISE 4503.) Generally offered: Spring. This course has Differential Tuition.

ISE 4563. Computer Integrated Manufacturing. (3-0) 3 Credit Hours.
Prerequisite: ME 3263 and ISE 3653*, or equivalents. Fundamental concepts and models related to computer-aided design, computer-aided process planning, computer-aided manufacturing, production planning and scheduling, and manufacturing execution systems, with practices on computer-aided applications and programming of automated production equipment. (Same as ME 4563. Credit cannot be earned for both ME 4563 and ISE 4563.) Generally offered: Spring. This course has Differential Tuition.

ISE 4573. Facilities Planning and Design. (3-0) 3 Credit Hours.
Prerequisite: ME 3263 or equivalent. Product, process, and schedule design, flow, space, and activity relationships, material handling, layout planning models and design algorithms, and warehouse operations. (Same as ME 4573. Credit cannot be earned for both ME 4573 and ISE 4573.) Generally offered: Spring. This course has Differential Tuition.

ISE 4583. Quality Engineering and Six Sigma. (3-0) 3 Credit Hours.
Prerequisite: ME 3263 or equivalent. Fundamental concepts, methodologies, and tools for the design, engineering and continuous improvement of enterprise operations. Topics include cost of poor quality, process capability, statistical quality control, Six Sigma for process design and improvement, and other contemporary process engineering approaches. (Same as ME 4583. Credit cannot be earned for both ME 4583 and ISE 4583. Formerly titled: "Enterprise Process Engineering.") Generally offered: Spring. This course has Differential Tuition. Course Fee: DL01 $75.

ISE 4653. Operations Research II. (3-0) 3 Credit Hours.
Prerequisite: ISE 3653* or equivalent. Introduction to advanced deterministic and stochastic modeling. Topics include Poisson processes, discrete and continuous-time Markov Chains, Dynamic Programming, and Queuing theory. Students will learn model formulation, solution strategies, and real-world applications in manufacturing and service systems. Applications include production planning, inventory control, scheduling, and revenue management. Generally offered: Fall. This course has Differential Tuition.

ISE 4713. Human Factors Engineering and Ergonomics. (3-0) 3 Credit Hours.
Prerequisite: ISE 3653* or equivalent. Fundamentals of human factors and ergonomics theory and methods, with emphasis on workplace and human-machine systems design. Topics include human body and sensing, posture, handling, and ergonomic design principles and cases. Generally offered: Spring. This course has Differential Tuition.

ISE 4723. Reliability in Engineering Design. (3-0) 3 Credit Hours.
Prerequisite: ME 3113 or ISE 3513*. Introduction to statistical methods in reliability and probabilistic engineering design methodology, statistical quality control and inspection, life prediction and testing, and design optimization (Same as ME 4723. Credit cannot be earned for both ME 4723 and ISE 4723.) This course has Differential Tuition.

ISE 4763. Integrated Production Systems. (3-0) 3 Credit Hours.
Prerequisite: ISE 3653*, ISE 4503*, and ISE 4583*, or equivalents. Design, planning, scheduling, and control of production systems with emphasis on systems thinking, modeling, and decision-making. Topics include inventory planning, production control, queueing models, and lean systems. Generally offered: Spring. This course has Differential Tuition.

ISE 4813. Senior Design I. (3-0) 3 Credit Hours.
Prerequisite: ISE 3653*, ISE 4503*, ISE 4583*, and ISE 4713*, or equivalents. Industrial engineering design project proposals, problem identification, systems modeling, analysis, and evaluation of opportunities for system improvement; presentation of conceptual designs. Industrial cooperation is encouraged. (Same as ME 4812. Formerly ME 4803, ME 4811, and ISE 4812. Credit can only be earned for one of the following: ME 4812, ME 4803, ME 4811, ISE 4812, and ISE 4813.) Generally offered: Fall. This course has Differential Tuition.

ISE 4823. Senior Design II. (3-0) 3 Credit Hours.
Prerequisite: EGR 3713, ISE 4713*, ME 4801, and ISE 4813*, or equivalents. Validation and implementation of solutions of an instructor-approved industrial engineering design project using computer-aided synthesis, analysis, modeling, optimization methods, and systems thinking. Industrial cooperation encouraged. Considerations of safety, reliability, environmental, and economic constraints, and ethical and social impacts. (Same as ME 4813. Credit cannot be earned for both ME 4813 and ISE 4823.) Generally offered: Spring. This course has Differential Tuition.

ISE 4911. Independent Study. 1 Credit Hour.
Prerequisite: Permission in writing (form available) from the instructor, the Department Chair, and Dean of the College. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours of independent study, regardless of discipline, will apply to a bachelor's degree. This course has Differential Tuition.

ISE 4913. Independent Study. (0-0) 3 Credit Hours.
Permission in writing (form available) from the instructor, the Department Chair, and Dean of the College. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours of independent study, regardless of discipline, will apply to a bachelor's degree. This course has Differential Tuition.

ISE 4953. Special Studies in Industrial and Systems Engineering. (3-0) 3 Credit Hours.
Will depend on the topic and must be identified before the course is scheduled. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Fall, Spring. This course has Differential Tuition.

B.S. in Industrial and Systems Engineering – Recommended Four-Year Academic Plan

First Year		
Fall		**Credit Hours**
AIS 1243 or AIS 1203	AIS: Engineering, Mathematics, and Sciences (core) or Academic Introduction and Strategies	3
CHE 1103	General Chemistry I	3
MAT 1213	Calculus I (core and major)	3
ME 1403	Engineering Practice and Graphics	3
WRC 1013	Freshman Composition I (core)	3
	Credit Hours	**15**
Spring		
MAT 1223 or EGR 1333	Calculus II or Calculus II for Engineers	3
PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory (core and major)	4
POL 1013	Introduction to American Politics (core)	3
WRC 1023	Freshman Composition II (core)	3
American History (core)		3
	Credit Hours	**16**
Second Year		
Fall		
ECO 2023	Introductory Microeconomics (core)	3
EGR 1403	Technical Communication (core)	3
EGR 2103	Statics	3
EGR 2302	Linear Algebra for Engineers	2
EGR 2313	Multivariable Calculus and Series for Engineers	3
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory (core and major)	4
	Credit Hours	**18**
Spring		
EE 2213	Electric Circuits and Electronics	3
EGR 3423	Differential Equations for Engineers	3
EGR 3713	Engineering Economic Analysis	3
ME 3243 & ME 3241	Materials Engineering and Materials Engineering Laboratory	4
STA 2303	Applied Probability and Statistics for Engineers	3
	Credit Hours	**16**
Third Year		
Fall		
ISE 3513	Inferential Statistics for Industrial Engineers *	3
ISE 3653	Operations Research I *	3

ME 3173	Numerical Methods	3
ME 3263	Manufacturing Engineering	3
Language, Philosophy, and Culture (core)		3
	Credit Hours	**15**
Spring		
ISE 4273	Systems Modeling and Simulation *	3
ISE 4503	Lean Manufacturing and Enterprise Engineering *	3
ISE 4583	Quality Engineering and Six Sigma *	3
ISE 4713	Human Factors Engineering and Ergonomics *	3
American History (core)		3
	Credit Hours	**15**
Fourth Year		
Fall		
ISE 4653	Operations Research II *	3
ISE 4723	Reliability in Engineering Design *	3
ISE 4813	Senior Design I *	3
Technical Elective		3
Technical Elective		3
Creative Arts (core)		3
	Credit Hours	**18**
Spring		
ISE 4573	Facilities Planning and Design *	3
ISE 4763	Integrated Production Systems *	3
ISE 4823	Senior Design II *	3
Technical Elective		3
Government-Political Science (core)		3
	Credit Hours	**15**
	Total Credit Hours	**128**

Bachelor of Science Degree in Mechanical Engineering

The Bachelor of Science degree in Mechanical Engineering offers students the opportunity to prepare for careers in traditional, new, and emerging technologies related to the practice of Mechanical Engineering, which is a versatile and broadly-based engineering discipline. Mathematics and basic sciences, such as physics and chemistry, form the foundation of mechanical engineering, which requires an understanding of diverse subject areas, such as solid and fluid mechanics, thermal sciences, mechanical design, structures, material selection, manufacturing processes and systems, mechanical systems and control, and instrumentation.

The Mechanical Engineering curriculum provides education and basic engineering training through the required coursework. Students may develop increased specialization and depth through the selection of technical elective courses. Development of open-ended, problem-solving skills is a part of many mechanical engineering courses. Design projects with formal report writing are included in many courses. In addition, a substantial portion of technical elective courses is devoted to the design of systems and components. A capstone design sequence at the senior level provides an opportunity to apply and integrate the knowledge gained throughout the curriculum to the development of an instructor-approved project.

The laboratory requirements are designed to provide hands-on experience in basic measurement and instrumentation equipment and the application of classroom theory. Students may receive additional hands-on experiences by selecting technical elective courses with laboratory components.

Opportunities exist for students to participate in research and design projects. All students are eligible to participate in undergraduate research, through the independent study courses. Students also have an opportunity to participate in an approved co-op program and may receive up to 3 semester credit hours for their experience.

Program Educational Objectives

The Mechanical Engineering Program prepares students to attain the following program educational objectives a few years after graduation:

1. Have engineering or other careers in industry, government, and/or will pursue advanced graduate or professional degrees.
2. Apply their engineering knowledge, critical thinking, creativity, and problem solving skills in professional engineering practice or in non-engineering fields.
3. Continue to advance their knowledge, communication, and leadership skills through graduate education, professional development courses, self-directed study, and/or on-the-job training and experience.
4. Apply their understanding of societal, environmental, and ethical issues to their professional activities.

Student Outcomes

Graduates of the UTSA Mechanical Engineering Program will demonstrate the following student outcomes. Attainment of these outcomes prepares graduates to enter the professional practice of engineering.

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. An ability to communicate effectively with a range of audiences
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

The minimum number of semester credit hours required for this degree is 128, at least 39 of which must be at the upper-division level. All candidates for this degree must fulfill the Core Curriculum requirements, the General Engineering requirements, and the degree requirements, listed below. A minimum grade of “C-” or better is required for all

mathematics, science, Engineering (EGR), and Mechanical Engineering (ME) courses in the curriculum.

Core Curriculum Requirements (42 semester credit hours)

Students seeking the Bachelor of Science degree in Mechanical Engineering must fulfill the University Core Curriculum requirements in the same manner as other students. The courses listed below satisfy both major requirements and Core Curriculum requirements; however, if these courses are taken to satisfy both requirements, then students may need to take additional courses in order to meet the minimum number of semester credit hours required for the degree.

MAT 1213 may be used to satisfy the core requirement in Mathematics, as well as one of the General Engineering requirements. PHY 1943 and PHY 1963 may be used to satisfy the core requirement in Life and Physical Sciences, as well as two of the General Engineering requirements. EGR 1403 may be used to satisfy the core requirement in the Component Area Option. ECO 2023may be used to satisfy the core requirement in the Social and Behavioral Sciences.

Core Curriculum Component Area Requirements (http://catalog.utsa.edu/undergraduate/bachelorsdegreeregulations/degreerequirements/corecurriculumcomponentarearequirements/)

First Year Experience Requirement	3
Communication	6
Mathematics	3
Life and Physical Sciences	6
Language, Philosophy and Culture	3
Creative Arts	3
American History	6
Government-Political Science	6
Social and Behavioral Sciences	3
Component Area Option	3
Total Credit Hours	**42**

General Engineering Requirements

Students seeking the Bachelor of Science degree in Mechanical Engineering must complete the following 22 semester credit hours:

Code	Title	Credit Hours
CHE 1103	General Chemistry I	3
EGR 2302	Linear Algebra for Engineers	2
EGR 3423	Differential Equations for Engineers	3
MAT 1213	Calculus I	3
MAT 1223	Calculus II	3
or EGR 1333	Calculus II for Engineers	
PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory	4
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory	4
Total Credit Hours		**22**

Gateway Courses

Students pursuing the Bachelor of Science degree in Mechanical Engineering must successfully complete each of the following Gateway Courses with a grade of "C-" or better in no more than two attempts. A student who is unable to successfully complete these courses within two attempts, including dropping a course with a grade of "W" or taking an equivalent course at another institution, will be required to change his or her major.

Code	Title	Credit Hours
EGR 2103	Statics	3
EGR 2513	Dynamics	3
EGR 3423	Differential Equations for Engineers	3
MAT 1213	Calculus I	3

Degree Requirements

Students seeking the Bachelor of Science degree in Mechanical Engineering must complete the following semester credit hours, as well as the Core Curriculum requirements and General Engineering requirements:

Code	Title	Credit Hours
A. Required foundation and general mechanical engineering courses:		
ECO 2023	Introductory Microeconomics	3
EE 2213	Electric Circuits and Electronics	3
EGR 2103	Statics	3
EGR 2313	Multivariable Calculus and Series for Engineers	3
or MAT 2213	Calculus III	
EGR 2513	Dynamics	3
EGR 3713	Engineering Economic Analysis	3
ME 1403	Engineering Practice and Graphics	3
ME 3113	Measurements and Instrumentation	3
ME 3173	Numerical Methods	3
ME 3241	Materials Engineering Laboratory	1
ME 3243	Materials Engineering	3
ME 3263	Manufacturing Engineering	3
ME 3293	Thermodynamics I	3
ME 3541	Dynamics and Controls Laboratory	1
ME 3543	Dynamic Systems and Control	3
ME 3663	Fluid Mechanics	3
ME 3813	Mechanics of Solids	3
ME 3823	Machine Element Design	3
ME 4293	Thermodynamics II	3
ME 4312	Thermal and Fluids Laboratory	2
ME 4313	Heat Transfer	3
ME 4801	Manufacturing Practices Laboratory	1
ME 4812	Senior Design I	2
ME 4813	Senior Design II	3
B. Mechanical Engineering elective courses		

Select 9 semester credit hours of Mechanical Engineering elective courses. Students are encouraged to choose courses from a specific group listed below. Students may also select courses to partially satisfy the requirements of a certificate in one of the following areas: 1) Aerospace Engineering; 2) Heating, Ventilation and Air Conditioning; 3) Industrial and Manufacturing Engineering; or 4) Oil/Gas. For detailed requirements, see the Certificates section of the Mechanical Engineering program.		9
Aerospace		
ME 3323	Mechanical Vibration	
ME 4123	Aerodynamics	
ME 4143	Propulsion	
ME 4153	Astrodynamics	
ME 4163	Aircraft Performance	
ME 4183	Compressible Flow	
ME 4603	Finite Element Analysis	
ME 4723	Reliability and Quality Control in Engineering Design	
Design and Control of Mechanical Systems		
ME 3323	Mechanical Vibration	
ME 3513	Mechanism Design	
ME 4553	Automotive Vehicle Dynamics	
ME 4723	Reliability and Quality Control in Engineering Design	
ME 4773	Robotics	
Energy, Thermal and Fluid Systems		
ME 4183	Compressible Flow	
ME 4323	Thermal Systems Design	
ME 4343	Heating, Air Conditioning, and Refrigeration Design	
ME 4593	Alternative Energy Sources	
ME 4613	Power Plant System Design	
ME 4623	Internal Combustion Engines	
Heating, Ventilation and Air-Conditioning		
ME 4323	Thermal Systems Design	
ME 4343	Heating, Air Conditioning, and Refrigeration Design	
ME 4593	Alternative Energy Sources	
ME 4613	Power Plant System Design	
ME 4953	Special Studies in Mechanical Engineering (SS in HVAC Controls)	
ME 4953	Special Studies in Mechanical Engineering (SS in Refrigeration)	
ME 4953	Special Studies in Mechanical Engineering (SS in Indoor Air Quality)	
Industrial and Manufacturing		
ME 3253	Medical Device Design and Commercialization	
ME 3273	Operations Research	
ME 4273	Systems Modeling and Analysis	
ME 4503	Lean Manufacturing and Enterprise Engineering	
ME 4543	Mechatronics	
ME 4563	Computer Integrated Manufacturing	
ME 4573	Facilities Planning and Design	
ME 4583	Enterprise Process Engineering	
ME 4723	Reliability and Quality Control in Engineering Design	
ME 4773	Robotics	
Mechanics and Materials		
ME 4243	Intermediate Materials Engineering	
ME 4603	Finite Element Analysis	
ME 4963	Mechanical Engineering Applications to Biomedical Systems	
Oil and Gas		
ME 3323	Mechanical Vibration	
ME 4323	Thermal Systems Design	
ME 4373	Separation Processes	
ME 4593	Alternative Energy Sources	
ME 4603	Finite Element Analysis	
ME 4643	Pressure Vessel and Piping Design	
ME 4653	Oil and Gas Engineering and Reservoir Geomechanics	
ME 4683	Corrosion Engineering	
Additional engineering elective courses		
EGR 3303	Engineering Co-op [1]	
EGR 4993	Honors Research [1]	
ME 3183	Python: Big Data in Engineering and Environmental Systems	
ME 4173	High Performance Computing	
ME 4913	Independent Study [1]	
ME 4953	Special Studies in Mechanical Engineering [1]	
Graduate Courses in Mechanical Engineering [2]		
C. 3 semester credit hours of approved mathematics or basic science elective courses, selected from the following list:		**3**
BIO 1233	Contemporary Biology I	
BIO 1243	Contemporary Biology II	
BIO 1203	Biosciences I for Science Majors	
BIO 3483	Biology of Human Reproduction	
CHE 1113	General Chemistry II	
CHE 2603	Organic Chemistry I	
ES 2013	Introduction to Environmental Science I	
GEO 1123	Life Through Time	
MAT 3013	Foundations of Mathematics	
MAT 3103	Data Analysis and Interpretation	
PHY 2103	Modern Physics	
PHY 3203	Classical Mechanics I	
STA 2303	Applied Probability and Statistics for Engineers	
STA 3003	Statistical Methods and Applications	
Total Credit Hours		**76**

[1] With prior approval, these courses may be used as a technical elective.

[2] Graduate courses require approval. Forms are available from your academic advisor.

B.S. in Mechanical Engineering – Recommended Four-Year Academic Plan

First Year		
Fall		**Credit Hours**
AIS 1243	AIS: Engineering, Mathematics, and Sciences	3
CHE 1103	General Chemistry I	3
MAT 1213	Calculus I (core and major)	3
ME 1403	Engineering Practice and Graphics	3
WRC 1013	Freshman Composition I (core)	3
	Credit Hours	**15**
Spring		
MAT 1223	Calculus II	3
PHY 1943	Physics for Scientists and Engineers I (core and major)	3
PHY 1951	Physics for Scientists and Engineers I Laboratory	1
POL 1013	Introduction to American Politics (core)	3
WRC 1023	Freshman Composition II (core)	3
American History (core)		3
	Credit Hours	**16**
Second Year		
Fall		
EGR 2103	Statics	3
EGR 2302	Linear Algebra for Engineers	2
EGR 2313	Multivariable Calculus and Series for Engineers	3
PHY 1963	Physics for Scientists and Engineers II (core and major)	3
PHY 1971	Physics for Scientists and Engineers II Laboratory	1
EGR 1403	Technical Communication (or other core option)	3
Math/Science Elective		3
	Credit Hours	**18**
Spring		
EE 2213	Electric Circuits and Electronics	3
EGR 2513	Dynamics	3
EGR 3423	Differential Equations for Engineers	3
ME 3241	Materials Engineering Laboratory	1
ME 3243	Materials Engineering	3
ME 3293	Thermodynamics I	3
	Credit Hours	**16**
Third Year		
Fall		
ME 3113	Measurements and Instrumentation	3
ME 3173	Numerical Methods	3
ME 3663	Fluid Mechanics	3
ME 3813	Mechanics of Solids	3
ME 4293	Thermodynamics II	3
Language, Philosophy & Culture (core)		3
	Credit Hours	**18**
Spring		
ME 3263	Manufacturing Engineering	3
ME 3541	Dynamics and Controls Laboratory	1
ME 3543	Dynamic Systems and Control	3
ME 3823	Machine Element Design	3
ME 4313	Heat Transfer	3
ECO 2023	Introductory Microeconomics (Social and Behavioral Sciences Core)	3
	Credit Hours	**16**
Fourth Year		
Fall		
EGR 3713	Engineering Economic Analysis	3
ME 4312	Thermal and Fluids Laboratory	2
ME 4801	Manufacturing Practices Laboratory	1
ME 4812	Senior Design I	2
POL 1133 or POL 1213	Texas Politics and Society (core) or Civil Rights in Texas and America	3
ME Technical elective		3
	Credit Hours	**14**
Spring		
ME 4813	Senior Design II	3
ME Technical elective		3
ME Technical elective		3
American History (core)		3
Creative Arts (core)		3
	Credit Hours	**15**
	Total Credit Hours	**128**

- Certificate in Aerospace Engineering (p. 8)
- Certificate in Heating, Ventilation and Air-Conditioning (p. 9)
- Certificate in Industrial and Manufacturing Engineering (p. 9)
- Certificate in Oil/Gas (p. 9)

Certificate in Aerospace Engineering

The Certificate in Aerospace Engineering is designed to prepare degree-seeking students or degree holders in mechanical engineering or related fields with the fundamental engineering knowledge necessary for successful careers in the aerospace industry. It certifies to employers that students awarded the certificate have completed coursework essential to success in entry-level positions in aerospace.

Eligibility requirements:

- Meet the prerequisite courses for the certificate program (refer to course descriptions in the *UTSA Undergraduate Catalog*)

Students pursuing an Aerospace Engineering certificate must complete 15 semester credit hours as follows:

Code	Title	Credit Hours
A. Required courses:		3
ME 3663	Fluid Mechanics	

B. ME electives. A minimum of three courses (9 semester credit hours) selected from the following list:		9-12
ME 4123	Aerodynamics	
ME 4143	Propulsion	
ME 4153	Astrodynamics	
ME 4163	Aircraft Performance	
ME 4183	Compressible Flow	
C. Additional electives. If only three courses are selected from list B, then an additional 3 semester credit hours must be completed from the following list:		0-3
ME 3323	Mechanical Vibration	
ME 4603	Finite Element Analysis	
ME 4683	Corrosion Engineering	
ME 4723	Reliability and Quality Control in Engineering Design	
Total Credit Hours		**15**

Certificate in Heating, Ventilation and Air-Conditioning

The Certificate in Heating, Ventilation and Air-Conditioning (HVAC) is designed to prepare degree-seeking students or degree holders in mechanical engineering or related fields with the fundamental engineering knowledge necessary for successful careers in the design, manufacture, selection, and/or installation of mechanical equipment which controls the built environment. It certifies to employers that students awarded the certificate have completed coursework essential to success in entry-level positions in HVAC related fields.

Eligibility requirements:

- Meet the prerequisite courses for the certificate program (refer to course descriptions in the *UTSA Undergraduate Catalog*)

Students pursuing a HVAC certificate must complete 15 semester credit hours as follows:

Code	Title	Credit Hours
A. Required courses:		3
ME 4313	Heat Transfer	
B. ME electives. A minimum of three courses (9 semester credit hours) selected from the following list:		9-12
ME 4323	Thermal Systems Design	
ME 4343	Heating, Air Conditioning, and Refrigeration Design	
ME 4613	Power Plant System Design	
ME 4953	Special Studies in Mechanical Engineering (SS in HVAC Controls)	
ME 4953	Special Studies in Mechanical Engineering (SS in Refrigeration)	
ME 4953	Special Studies in Mechanical Engineering (SS in Indoor Air Quality)	
C. Additional electives. If only three courses are selected from list B, then an additional 3 semester credit hours must be completed.		0-3
ME 4593	Alternative Energy Sources	
Total Credit Hours		**15**

Certificate in Industrial and Manufacturing Engineering

The Certificate in Industrial and Manufacturing Engineering is designed to prepare degree-seeking students or degree holders in mechanical engineering or related fields with the fundamental engineering knowledge necessary for successful careers in the manufacturing industry. It certifies to employers that students awarded the certificate have completed coursework essential to success in entry-level engineering positions in manufacturing.

Eligibility requirements:

- Meet the prerequisite courses for the certificate program (refer to course descriptions in the *UTSA Undergraduate Catalog*)

Students pursuing an Industrial and Manufacturing Engineering certificate must complete 15 semester credit hours as follows:

Code	Title	Credit Hours
A. Required courses:		3
ME 3263	Manufacturing Engineering	
B. ME electives. A minimum of three courses (9 semester credit hours) selected from the following list:		9-12
ME 3253	Medical Device Design and Commercialization	
ME 3273	Operations Research	
ME 4273	Systems Modeling and Analysis	
ME 4503	Lean Manufacturing and Enterprise Engineering	
ME 4563	Computer Integrated Manufacturing	
ME 4573	Facilities Planning and Design	
ME 4583	Enterprise Process Engineering	
ME 4723	Reliability and Quality Control in Engineering Design	
C. Additional electives. If only three courses are selected from list B, then an additional 3 semester credit hours must be completed from the following list:		0-3
ME 4543	Mechatronics	
ME 4773	Robotics	
Total Credit Hours		**15**

Certificate in Oil/Gas

The Certificate in Oil/Gas is designed to prepare mechanical engineering degree-seeking students and non-degree-seeking students with mechanical engineering background with the fundamental engineering knowledge necessary for successful careers in Oil/Gas Industry. It certifies to employers that students awarded the certificate have completed coursework essential to Oil/Gas industry.

Eligibility requirements:

- Meet the prerequisite courses for the certificate program (refer to course descriptions in the *UTSA Undergraduate Catalog*)

Students pursuing an Oil/Gas certificate must complete 15 semester credit hours as follows:

Code	Title	Credit Hours
A. Required courses:		3
ME 3823	Machine Element Design [1]	
B. ME electives. A minimum of three courses (9 semester credit hours) selected from the following list:		9-12
ME 3323	Mechanical Vibration	
ME 4323	Thermal Systems Design	
ME 4373	Separation Processes	
ME 4593	Alternative Energy Sources	
ME 4643	Pressure Vessel and Piping Design	
ME 4653	Oil and Gas Engineering and Reservoir Geomechanics	
ME 4683	Corrosion Engineering	
C. Additional electives. If only three courses are selected from list B, then take ME 4603 for an additional 3 credits.		0-3
Total Credit Hours		**15**

[1] Those students who have transferred equivalent required and elective courses, as listed above, from other institutions may complete the certificate program by taking 15 semester credit hours of ME courses listed above.

To earn any certificate in the mechanical engineering program, students must satisfy the following requirements:

1. Complete all the requirements of the certificate program.
2. Receive a grade of "C-" or better in each course used to satisfy the requirements of the certificate program.
3. Achieve at least a 2.5 grade point average (on a 4.0 scale) in all courses used to satisfy the requirements of the certificate program.

Undergraduates who are currently enrolled in the baccalaureate degree program in mechanical engineering or enrolled as non-degree-seeking students and who wish to earn an undergraduate certificate offered by the mechanical engineering program are eligible to enroll in the certificate program, provided they satisfy the course prerequisite requirements.

Students not currently admitted to UTSA who wish to earn an undergraduate certificate offered by the mechanical engineering program will be required to apply for admission to UTSA as special (non-degree-seeking) students at the undergraduate level and indicate in the application process their desire to pursue the requirements for specific undergraduate certificate program. Applicants will be required to meet University admission requirements for special students at the undergraduate level.

Students who are pursuing a certificate as non-degree-seeking students will not be eligible for financial aid or Veterans Administration educational benefits.

Graduate students may enroll in the undergraduate certificate programs, provided they meet the requirements for enrollment in the certificate program.

During the last semester in the certificate program, students must submit an application for the Undergraduate Certificate to the Office of the Registrar.

Mechanical Engineering (ME) Courses

ME 1403. Engineering Practice and Graphics. (2-3) 3 Credit Hours. (TCCN = ENGR 1304)
Prerequisites: MAT 1093 and completion of or concurrent enrollment in WRC 1013. Introduction to engineering practice and engineering graphics: geometric constructions, multi-view drawing, dimensioning, sections, pictorials and auxiliary views. Computer-aided design, generation of mechanical drawings, and design projects. (Formerly ME 1402. Credit cannot be earned for both ME 1402 and ME 1403.) Course Fees: LRE1 $25; STSE $30.

ME 3113. Measurements and Instrumentation. (2-3) 3 Credit Hours.
Prerequisites: EE 2213, EGR 2513, PHY 1951, and PHY 1971. Fundamentals of measurement systems theory and laboratory practice. Descriptive statistics, probability distributions, error, uncertainty analysis, technical report writing, and data acquisition. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: L001 $30; DL01 $75.

ME 3173. Numerical Methods. (2-3) 3 Credit Hours.
Prerequisite: EGR 3423. Introduction to numerical algorithms to solve science and engineering problems. Construction and derivation of numerical algorithm as well as application limits. Various numerical approaches in finding roots of linear and non-linear functions, regression analysis, interpolation, curve fitting procedures, differentiation, integration, solutions of system of linear algebraic equations, solutions of ordinary differential equations and boundary value problems. (Formerly ME 2173. Credit cannot be earned for both ME 3173 and ME 2173.) Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: LRE1 $25; STSE $30; DL01 $75.

ME 3183. Python: Big Data in Engineering and Environmental Systems. (3-0) 3 Credit Hours.
Prerequisite: ME 3173 (or ME 2173 in previous catalogs), or equivalent. Introduction to Python as a programming language and to several modules of Python specific to scientific computing. Understanding physical principles of engineering systems from data using Python platform. The course introduces scientific data analysis including statistical analysis of stochastic processes and numerical methods for big data. This course has Differential Tuition.

ME 3241. Materials Engineering Laboratory. (0-3) 1 Credit Hour.
Prerequisite: Concurrent enrollment in or completion of ME 3243. Investigation of the mechanical properties of engineering materials, with emphasis on metals, sample preparation, and metallography. (Formerly ME 3244. Credit cannot be earned for both ME 3244 and ME 3241.) This course has Differential Tuition. Course Fee: L001 $30.

ME 3243. Materials Engineering. (3-0) 3 Credit Hours.
Prerequisites: CHE 1103, EGR 2103, and concurrent enrollment in or completion of ME 3241. Fundamentals in atomic structure, microstructures, properties, and mechanical behavior of engineering materials, such as metals, polymers, and ceramics. (Formerly ME 3244. Credit cannot be earned for both ME 3244 or ME 3243 and ME 3241. Prior completion of ME 3244 can be substituted for ME 3243 and ME 3241.) Generally offered: Fall, Spring. This course has Differential Tuition. Course Fee: DL01 $75.

ME 3253. Medical Device Design and Commercialization. (3-0) 3 Credit Hours.
Prerequisite: ME 3173 (or ME 2173 in previous catalogs), or equivalent. Introduction to medical device development, clinical perspective in approaching design, medical design process, relevant regulatory policies, manufacturing concerns, military medicine, dentistry, medtech entrepreneurship, and medical robotics. The course materials and experiential learning will enable students to examine how the interdependent roles of medical care, engineering, technology, and policy impact device design in contemporary medicine. This course has Differential Tuition.

ME 3263. Manufacturing Engineering. (3-0) 3 Credit Hours.
Prerequisites: EGR 2513, ME 3241, and ME 3243 (or ME 3244 in previous catalogs). Manufacturing processes, quality assurance, statistical methods, economic analysis, planning, and communication. (Formerly titled "Materials Processing.") Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

ME 3273. Operations Research. (3-0) 3 Credit Hours.
Prerequisite: ME 3173 (or ME 2173 in previous catalogs), or equivalent. Introduction to fundamental optimization models and solution methods, including linear programs, the simplex method, duality theory, sensitivity analysis, integer programs, and network flows. Focus on formulating and solving practical operations research problems and the use of optimization software. This course has Differential Tuition.

ME 3293. Thermodynamics I. (3-0) 3 Credit Hours.
Prerequisite: EGR 2103 and MAT 1223 (or MAT 1224 in previous catalogs). Heat, work, equations of state, thermodynamics systems, control volume, first and second laws of thermodynamics, applications of the laws of thermodynamics, reversible and irreversible processes, and introduction to basic thermodynamic cycles. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: DL01 $75.

ME 3323. Mechanical Vibration. (3-0) 3 Credit Hours.
Prerequisite: EGR 2513 and EGR 3423. Free and forced vibrations, single and multiple degree of freedom systems, damping, matrix methods, time-domain and frequency-domain. Applications in the transmission and control of vibration. Generally offered: Spring. This course has Differential Tuition.

ME 3513. Mechanism Design. (3-0) 3 Credit Hours.
Prerequisite: EGR 2513 and ME 1403. Introduction to mechanisms, graphical and linear analytical methods for kinematic synthesis of mechanisms; design of cam follower; gearing fundamentals, ordinary and planetary gear trains; and computer-aided design projects. This course has Differential Tuition.

ME 3541. Dynamics and Controls Laboratory. (0-3) 1 Credit Hour.
Prerequisites: ME 3113 and concurrent enrollment in or completion of ME 3543. Investigation of the dynamics and control of physical systems. (Formerly ME 4733. Credit cannot be earned for both ME 4733 and ME 3541.) This course has Differential Tuition.

ME 3543. Dynamic Systems and Control. (3-0) 3 Credit Hours.
Prerequisite: EGR 2513, EGR 3423, and concurrent enrollment in or completion of ME 3113. Introduction to modeling and control of dynamic physical systems, analysis and design of control systems for mechanical, electrical, manufacturing, fluid, and thermal systems. (Formerly ME 4522 and ME 4523. Credit cannot be earned for more than one of the following: ME 3543, ME 4522, or ME 4523.) Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: DL01 $75.

ME 3663. Fluid Mechanics. (3-0) 3 Credit Hours.
Prerequisite: EGR 2513, EGR 3423, and completion of or concurrent enrollment in ME 3293. Fluid properties, fluid statics, integral and differential analysis of fluid flow, viscous laminar and turbulent flow in conduits, dimensional analysis, boundary layer concepts, drag and lift. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: DL01 $75.

ME 3813. Mechanics of Solids. (3-0) 3 Credit Hours.
Prerequisite: EGR 2103 and MAT 1223 (or MAT 1224 in previous catalogs). Internal forces and deformations in solids, stress, strain and their relations, torsion, stresses and deflections in beams, and elastic behavior of columns. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: DL01 $75.

ME 3823. Machine Element Design. (3-0) 3 Credit Hours.
Prerequisites: ME 1403, ME 3241, ME 3243 (or ME 3244 in previous catalogs), and ME 3813. Introduction to design of machine elements, materials selection, static and fatigue failures, shafts, fasteners, springs, gears, bearings and design projects. (Formerly ME 4423. Credit cannot be earned for both ME 3823 and ME 4423.) Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fee: DL01 $75.

ME 4123. Aerodynamics. (3-0) 3 Credit Hours.
Prerequisite: ME 3293 and ME 3663. Fundamental principles of Aerodynamics, background review, inviscid incompressible flow, flow over airfoils and finite wings, Panel method, compressible flow and shockwaves including supersonic flow, oblique shock and expansion waves, subsonic compressible flow over airfoils, linearized flows in aerodynamics, concepts in viscous flow, and Computational methods in Aerodynamics. This course has Differential Tuition.

ME 4143. Propulsion. (3-0) 3 Credit Hours.
Prerequisite: ME 3293 and ME 3663. Application of thermodynamics and fluid mechanics to the analysis of problems related to the propulsion of aerospace vehicles. Development of control volume analysis techniques for compressible flow problems, with applications in the design and analysis of rocket nozzles and state-of-the-art propulsion systems like ramjets, scramjets, and detonation cycle systems. This course has Differential Tuition.

ME 4153. Astrodynamics. (3-0) 3 Credit Hours.
Prerequisite: ME 3543. Two-body orbital mechanics, introduction to reference frames, orbit elements representation, the solar system as a set of orbiting bodies, orbit determination, orbital maneuvers, interplanetary trajectories, and common orbital perturbations. This course has Differential Tuition.

ME 4163. Aircraft Performance. (3-0) 3 Credit Hours.
Prerequisite: ME 3293 and ME 3663. Study of aircraft performance using the governing equations of fluid dynamics, atmospheric properties, and the concepts of lift and drag. Analysis of level flight performance, rates of climb, service and absolute ceilings, range, take-off and landing, and turn performance. Study of longitudinal and lateral stability applied to aircraft. This course has Differential Tuition.

ME 4173. High Performance Computing. (3-0) 3 Credit Hours.
Prerequisite: ME 3173 (or ME 2173 in previous catalogs), or equivalent. Introduction to UNIX (login, shell scripts, editors, file permissions), visualization (software tools, data formats), Parallel programming (numerical libraries, Message Passing Interface, Trilinos, GPGPU programming). This course has Differential Tuition.

ME 4183. Compressible Flow. (3-0) 3 Credit Hours.
Prerequisites: ME 3293 and ME 3663. Analysis of one-dimensional steady compressible flow, isentropic flow, compressible boundary layers, transition from subsonic to supersonic flow, Fanno and Rayleigh flow, supersonic nozzle design, normal and oblique shock waves, and expansion fans. (Formerly EGR 4183. Credit cannot be earned for both ME 4183 and EGR 4183.) This course has Differential Tuition.

ME 4243. Intermediate Materials Engineering. (3-0) 3 Credit Hours.
Prerequisite: ME 3241, ME 3243 (or ME 3244 in previous catalogs), and ME 3813. Selected topics in fabrication and processing of materials; macroscopic and microscopic aspects of the mechanical behavior of metals, ceramics, polymers and composites; Failure mode analysis in materials; optimization of material selection in the design process. This course has Differential Tuition.

ME 4273. Systems Modeling and Analysis. (3-0) 3 Credit Hours.
Prerequisite: ME 3173 (or ME 2173 in previous catalogs); and ME 3113. Systems analysis approach to formulating and solving engineering problems. Topics include mathematical modeling, discrete event simulation, and decision analysis. Focus on applying systems modeling methods on practical industrial problems and the use of simulation software. This course has Differential Tuition.

ME 4293. Thermodynamics II. (3-0) 3 Credit Hours.
Prerequisite: ME 3293. Energy and (availability) analysis, reactive and nonreactive mixtures, moist air properties, psychometric systems and analysis, vapor and gas power cycles, refrigeration and heat-pump cycles, and thermodynamic relations. Generally offered: Fall, Spring. This course has Differential Tuition.

ME 4312. Thermal and Fluids Laboratory. (0-6) 2 Credit Hours.
Prerequisites: ME 3113, ME 4293, and concurrent enrollment in or completion of ME 4313. Investigation of thermal and fluid physical systems, and design of experiments. (Formerly ME 4733. Credit cannot be earned for both ME 4733 and ME 4312.) This course has Differential Tuition.

ME 4313. Heat Transfer. (3-0) 3 Credit Hours.
Prerequisite: EGR 3423, ME 3173 (or ME 2173 in previous catalogs), ME 3293, and ME 3663. Generalized potential distribution and gradients, and heat transfer, including transient and steady state conduction, forced and free convection, radiation, and heat exchanger analysis. Generally offered: Fall, Spring. This course has Differential Tuition.

ME 4323. Thermal Systems Design. (3-0) 3 Credit Hours.
Prerequisite: ME 4313. Application of thermodynamics, fluid mechanics, heat transfer, and computer methods to the design of thermal energy systems. This course has Differential Tuition.

ME 4343. Heating, Air Conditioning, and Refrigeration Design. (3-0) 3 Credit Hours.
Prerequisite: ME 4293. Moist air properties, human comfort, solar radiation, heating/cooling loads, design selection, operation of air conditioning equipment, and duct design. This course has Differential Tuition.

ME 4373. Separation Processes. (3-0) 3 Credit Hours.
Prerequisite: ME 4293. Rate- and equilibrium-controlled separation, mass transfer, phase equilibrium, distillation, and extraction. This course has Differential Tuition. Course Fee: LRE1 $25; STSE $30.

ME 4503. Lean Manufacturing and Enterprise Engineering. (3-0) 3 Credit Hours.
Prerequisite: ME 3263. Concepts and applications of Lean Systems applied to manufacturing and non-manufacturing environments. Topics include lean fundamentals and various tools and methodologies for transformation of companies and organizations into globally competitive enterprises. Team project on Value Streaming Mapping analysis of processes in real settings is required. This course has Differential Tuition.

ME 4543. Mechatronics. (2-3) 3 Credit Hours.
Prerequisite: ME 3113. Modeling and analysis of electrical (resistors, capacitors, inductors, diodes, transistors, operational amplifiers, combinational logic and sequential logic) and mechanical systems (spring mass damper), data acquisition and measurements, sensors, actuators, and micro-controller programming. A lab component with emphasis on building electrical circuits, data acquisition using LabVIEW, and integration of sensors, actuators, and micro-controller programming (Arduino) to create a mechatronics system. Generally offered: Fall, Spring. This course has Differential Tuition. Course Fee: L001 $30; DL01 $75.

ME 4553. Automotive Vehicle Dynamics. (3-0) 3 Credit Hours.
Prerequisite: EGR 2513 and EGR 3423. Dynamics and control of automotive systems, handling, tires, suspension, steering, and aerodynamic forces. This course has Differential Tuition.

ME 4563. Computer Integrated Manufacturing. (3-0) 3 Credit Hours.
Prerequisite: ME 3263. Fundamental concepts and models related to computer-aided design, computer-aided process planning, computer-aided manufacturing, production planning and scheduling, and manufacturing execution systems. Laboratory work includes computer-aided applications and programming of automated production equipment. This course has Differential Tuition.

ME 4573. Facilities Planning and Design. (3-0) 3 Credit Hours.
Prerequisite: ME 3263. Product, process, and schedule design, flow, space, and activity relationships, material handling, layout planning models and design algorithms, and warehouse operations. This course has Differential Tuition.

ME 4583. Enterprise Process Engineering. (3-0) 3 Credit Hours.
Prerequisite: ME 3263. Fundamental concepts, methodologies, and tools for the design, engineering and continuous improvement of enterprises. Topics include Six Sigma for process design and improvement, lean manufacturing fundamentals, value-stream mapping, performance evaluation, and other contemporary enterprise process engineering approaches. Generally offered: Fall. This course has Differential Tuition. Course Fee: DL01 $75.

ME 4593. Alternative Energy Sources. (3-0) 3 Credit Hours.
Prerequisite: ME 3173 (or ME 2173 in previous catalogs), ME 3113, ME 3663, and ME 4293. Nuclear, geothermal, solar, biomass, wind, and hydrogen energy sources. Resources, production, utilization, economics, sustainability, and environmental considerations. (Formerly ME 3593. Credit cannot be earned for both ME 3593 and ME 4593.) This course has Differential Tuition.

ME 4603. Finite Element Analysis. (3-0) 3 Credit Hours.
Prerequisite: EGR 3423, ME 3173 (or ME 2173 in previous catalogs), and ME 3823. Finite element method fundamentals, advanced geometric modeling of mechanical components and systems, and finite element modeling of components. This course has Differential Tuition.

ME 4613. Power Plant System Design. (3-0) 3 Credit Hours.
Prerequisite: ME 4293. Application of thermodynamics and fluid mechanics to the design of vapor and gas-turbine power plant systems including boilers, condensers, turbines, pumps, compressors, and cooling towers. This course has Differential Tuition.

ME 4623. Internal Combustion Engines. (3-0) 3 Credit Hours.
Prerequisite: ME 4293. Application of thermodynamic cycles in design, analysis, and modeling of internal combustion engines including spark-ignition and compression-ignition cycles, thermochemistry, fuels, combustion, emissions, and pollution. This course has Differential Tuition.

ME 4643. Pressure Vessel and Piping Design. (3-0) 3 Credit Hours.
Prerequisite: ME 3663 and ME 3813. ASME Section XIII Boiler and Pressure Vessel code, inspection, maintenance, repair, and modification of pressure vessels. Piping design and construction. This course has Differential Tuition. Course Fee: LRE1 $25; STSE $30.

ME 4653. Oil and Gas Engineering and Reservoir Geomechanics. (3-0) 3 Credit Hours.
Prerequisite: ME 3663 and ME 3813. Introduction to the oil and gas industry, Measurement; deformation mechanisms in rock; rock fracture description and analysis; wellbore stresses and failure; wellbore stability analysis; fault stability analysis; depletion-induced reservoir deformation; and hydraulic fracturing. This course has Differential Tuition.

ME 4683. Corrosion Engineering. (3-0) 3 Credit Hours.
Prerequisites: ME 3241 and ME 3243 (or ME 3244 in previous catalogs). Principles of electrochemistry, fundamentals of the environmental degradation of materials, corrosion thermodynamics and kinetics, corrosion phenomenology, and corrosion control and prevention. This course has Differential Tuition. Course fee: DL01 $75.

ME 4723. Reliability and Quality Control in Engineering Design. (3-0) 3 Credit Hours.
Prerequisite: ME 3113. Introduction to statistical methods in reliability and probabilistic engineering design methodology, statistical quality control and inspection, life prediction and testing, and design optimization. Generally offered: Fall. This course has Differential Tuition. Course Fee: DL01 $75.

ME 4773. Robotics. (3-0) 3 Credit Hours.
Prerequisite: EGR 2513; and ME 3173 (or ME 2173 in previous catalogs). Kinematics, dynamics, planning and control of mobile robots and manipulators. Special topics may include legged robots, soft robots, climbing robots, advanced control methods, image processing, computer vision, estimation. A LEGO-based laboratory with emphasis on prototyping robotic systems for practical applications. This course has Differential Tuition.

ME 4801. Manufacturing Practices Laboratory. (0-3) 1 Credit Hour.
Prerequisite: Concurrent enrollment in, or completion of, ME 3263. This lab includes the use of measurement tools, saw, drill, mill, lathe, and welder. This course has Differential Tuition. Course Fee: L001 $15.

ME 4812. Senior Design I. (2-0) 2 Credit Hours.
Prerequisites: ME 3113, ME 3263, ME 3543, ME 3663, ME 3823, and ME 4293; completion of or concurrent enrollment in ME 4313, ME 4801, ME 4312, and EGR 3713 or ME 4543 required. Design project proposals, computer-aided synthesis, analysis, and modeling of an open-ended problem development and presentation of conceptual designs. Industrial cooperation is encouraged. This course, as well as ME 4313, ME 4543, ME 4801, and ME 3541, must be completed with a grade of "C-" or better to serve as prerequisites for ME 4813. (Formerly ME 4811 and ME 4803. Credit cannot be earned for more than one of the following: ME 4812, ME 4803, or ME 4811.) This course has Differential Tuition. Course fee: DL01 $50.

ME 4813. Senior Design II. (2-3) 3 Credit Hours.
Prerequisites: ME 3541, ME 4312, ME 4313, ME 4801, ME 4812, and EGR 3713 or ME 4543. Development of a working design of an instructor-approved design project using computer-aided synthesis, analysis, modeling, and optimization methods. Industrial cooperation encouraged. Considerations of safety, reliability, environmental, and economic constraints, and ethical and social impacts. Generally offered: Fall, Spring. This course has Differential Tuition. Course Fee: L001 $30; DL01 $75.

ME 4911. Independent Study. (0-0) 1 Credit Hour.
Prerequisite: Permission in writing (form available) from the instructor, the Department Chair, and Dean of the College. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours of independent study, regardless of discipline, will apply to a bachelor's degree. This course has Differential Tuition.

ME 4913. Independent Study. (0-0) 3 Credit Hours.
Prerequisite: Permission in writing (form available) from the instructor, the Department Chair, and Dean of the College. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours of independent study, regardless of discipline, will apply to a bachelor's degree. This course has Differential Tuition.

ME 4953. Special Studies in Mechanical Engineering. (3-0) 3 Credit Hours.
Prerequisite: Will depend on the topic and must be identified before the course is scheduled; the minimum prerequisite must be ME 3173 (or ME 2173 in previous catalogs), or a higher-level engineering course depending on the topic. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Fall, Spring. This course has Differential Tuition. Course Fee: DL01 $75.

ME 4963. Mechanical Engineering Applications to Biomedical Systems. (3-0) 3 Credit Hours.
Prerequisite: EGR 2513, ME 3663, and ME 3813. Applications of dynamics, solid mechanics and fluid mechanics to biomedical systems. (Formerly titled Bioengineering.) This course has Differential Tuition. Course Fee: LRE1 $25; STSE $30.