

UNDERGRADUATE CURRICULUM CHANGE MEMO

Date: January 6, 2020

From: Louis J. Everett, Mechanical Engineering MECH

Through: Jack Chessa, Department Chair Mechanical Engineering

Through: Louis Everett, Chair of Curriculum Committee, College of Engineering

Through: Norman Love, Associate Dean for Academic Affairs and Undergraduate Studies, College of Engineering

Through: Theresa Maldonado, Dean, College of Engineering

To: Carla Ellis, Chair of University Curriculum Committee

Proposal Title: **Aerospace Engineering Degree Plan and Curriculum**

Explain the nature of the change and the rationale.

The aerospace and defense industries are growing at significant rates and are expected to continue growing. There continues to be an all-time high aircraft order backlog in the commercial sector with demand for next-generation, fuel-efficient aircraft. The demand is expected to continue for at least the next two decades. Defense spending is also expected to continue; in 2019 the US national defense budget grew \$17 billion. There is a high demand for aerospace engineers.

The aerospace and defense workforce have been contracting for the past two decades and the shortage of highly educated engineers is now a national security concern. There is an insufficient number of aerospace engineers being produced, especially from underrepresented groups.

Recent multi-million-dollar research programs, established within UTEP's Mechanical Engineering Department, have been producing high quality graduates. Last year alone more than 26 doctoral, 24 master's, and 40 undergraduate students (81% Hispanic, 32% female) were funded from external research money. These students worked on 15 different projects and produced more than 63 publications. UTEP is producing high quality aerospace graduates from underrepresented groups.

The department has hired four faculty focusing on aerospace. The Spacecraft Fabrication Laboratory has been established on campus. The tRIAc Research Park has been constructed at Fabens, Texas, where large testing programs are run. The viability of the UTEP program is certain.

Recent graduates have been placed in aerospace and defense industry and national laboratories.

To continue this growth and better prepare graduates for the aerospace and defense industries, the Mechanical Engineering department is proposing an Aerospace Engineering Curriculum. The new degree program uses much of the Mechanical Engineering basics and creates specialized courses focused in 3 concentrations: Aircraft, Launch Vehicles and Missiles, and Satellites.

CURRICULUM CHANGE PROPOSAL

APPROVAL PAGE

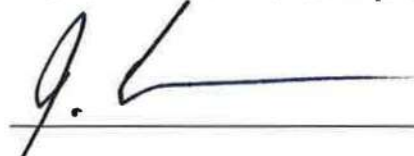
Proposal Title: Aerospace Engineering Degree Plan and Curriculum

College: Engineering

Department: Mechanical Engineering

DEPARTMENT CHAIR

I have read the enclosed proposal and approve this proposal on behalf of the department.



Signature

2/6/2020

Date

COLLEGE CURRICULUM COMMITTEE CHAIR

I have read the enclosed documents and approve the proposal on behalf of the college curriculum committee.



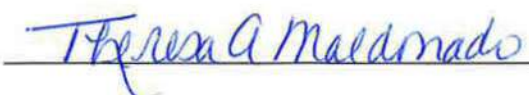
Signature

2/7/20

Date

COLLEGE DEAN

I have read the enclosed documents and approve the proposal on behalf of the college. I certify that the necessary funds will be allocated by the college in support of this proposal.



Signature

2/18/2020

Date

University of Texas at El Paso
Mechanical Engineering Dept.
 Phone: (915) 747-5450 <http://me.utep.edu/>
2020 B.S. in Aerospace Engineering Degree Plan

Year	Semester I			Hrs	Semester II			Hrs
Freshman	MECH	1305	Graphic and Design Fundamentals +	3	MECH	1321	Mechanics I – Statics + (MATH 1411+ PHYS 2420+)	3
	RWS	1301	Rhetoric & Composition I +	3	HIST	1301	History of US to 1865 +	3
	MATH	1411	Calculus I +	4	RWS	1302	Rhetoric & Composition 2 + (RWS 1301+)	3
	PHYS	2420	Physics I (MATH 1411 is CO requisite)	4	MATH	1312	Calculus II + (MATH 1411+)	3
	UNIV	1301	Foundations of Engineering - can be taught in a specific section. +	3	CHEM CHEM	1305 1105	Chemistry I +	4
				17				16
Sophomore	MECH	2322	Mechanics of Materials + (MECH 1321+)	3	MECH	2340	Mechanics II – Dynamics + (MECH 1321+)	3
	MATH	2313	Calculus III + (MATH 1312+)	3	MECH	2311	Introduction to Thermo-Fluid Science + (MATH 1312+)	3
	AERO	2331	Aerospace materials + (CHEM 1305+, CHEM 1105 +)	3	MECH	2103	Engineering Computations +	1
	AERO	2131	Aerospace Materials Lab + (MECH 1305+)	1	MECH	2342	Electro Mechanical Systems + (MATH 1312+)	3
	HIST	1302	History of US since 1865 +	3	CE	2326	Engineering Economics +	3
			Science Elective + (see NOTE 1)	4	MATH	2326	Differential Equations +	3
					17			
Junior			Laboratory Experience (see NOTE 2)	1			Laboratory Experience (see NOTE 2)	1
	MECH	3352	Engineering Analysis (MECH 2351+)	3	COMM	1302	Business and Professional Communication +	3
	AERO	3312	Aerodynamics I	3	AERO	3343	System Modelling and Control (MATH 2326 +, MECH 2342 +, MECH 2340 +)	3
	AERO		Concentration Course I (See NOTE 5)	3	AERO	3323	Aerospace Structures 1 (AERO 2331 +, MECH 2322 +)	3
	POLS	2310	Introduction to Politics +	3	AERO		Concentration Course II (See NOTE 5)	3
	MATH		Math Elective + (see NOTE 3)	3			Science/Math Elective + (see NOTE 4)	3
					16			
Senior	AERO		Aero concentration III (NOTE 5)	3	AERO	4366	Aerospace Senior Design (AERO 4322, AERO 4365, AERO 3323, AERO 3343, AERO 3312, MECH 3352)	3
	AERO	4322	Aerospace Propulsion (MECH 2311 +, CHEM 1305 +)	3	AERO	4364	Aerospace Communications (MECH 2342 +)	3
			Technical Elective (See Note 6)	3			Technical Elective (NOTE 6)	3
	AERO	4365	Aerospace Systems Engineering (CE 2326 +, COMM 1302 +)	3	POLS	2311	American Government and Politics	3
			Humanities Electives +	3			Visual and Performing Art Elective	3
					15			
Total 128 Credit hrs								

Red indicates AERO specific courses, Black indicates established courses in other disciplines

Laboratory Experience			
MECH	3123	Solid Mechanics Lab (MECH 2322+)	1
MECH	3113	Thermo-fluid Lab (MECH 2311+)	1
MECH	3103	Mechatronics Lab (MECH 2342+)	1

Aircraft Concentration			
AERO	4311	Flight Dynamics and Control (AERO 3343, AERO 3312)	3
AERO	4312	Aircraft Design	3
AERO	4313	Aerospace Structures II (AERO 3323) (MECH 2340 +, MECH 2342 +)	3
AERO	4319	Special Topics in Aeronautics	3

Launch Vehicles and Missiles Concentration (includes Hypersonics)			
AERO	4331	Aerodynamics II (Supersonic and Hypersonic)	3
AERO	4332	Hypersonic Vehicle Design	3
AERO	4335	Structural Dynamics (AERO 2340 +, MECH 2342 +)	3
AERO	4339	Special Topics in Hypersonics	3

Satellite Concentration			
AERO	4351	Orbit and Attitude Dynamics (AERO 3343, MATH 2326 +)	3
AERO	4353	Space Environments (MATH 2326 +, PHYS 2420 +)	3
AERO	4355	Space Mission Design	3
AERO	4359	Special Topics in Astronautics	

Notes: Prerequisites listed in parentheses, +Grade of C or better required

1. Must be either CHEM 1306 with CHEM 1106, PHYS 2421 or by permission of advisor.
2. From the department approved list of Laboratory Experience courses.
3. Selected from MATH 3323, 3335, 4326, 4329, 4336, STAT 3320. By completing 3 of these electives you may be eligible for a Mathematics minor, interested students should consult the Department of Mathematics.
4. Approved courses are: PHYS 2325, PHYS 3351, PHYS 4348 or any course listed in NOTE 3 (not already taken). Also, as per the UTEP core curriculum requirements two of your science classes must be in the same area (either PHYS, OR CHEM).
5. Must take at least three classes from one aerospace concentration area.
6. Two technical electives selected from any MECH or AERO 3XXX or 4XXX courses. At least one elective must be at the 4XXX level.



**Texas Higher Education Coordinating Board
Texas Public General Academic and Health-Related Institutions**

Proposal for a New Bachelor's or Master's Degree Program

Directions: Texas public institutions of higher education must complete this form to propose: (1) Bachelor's or Master's Degree programs in engineering; (2) Bachelor's or Master's degree programs that have an estimated cost of more than \$2 million in the first five years of operation; and/or (3) Bachelor's or Master's degree programs that do not meet the certification requirements set forth in [Texas Administrative Code \(TAC\), Title 19, Chapter 5, Subchapter C, Section 5.44 \(a\) \(3\)](#).

Institutions should notify the Division of Academic Quality and Workforce of its intent to plan a new engineering program with a letter submitted through the [Document Submission Portal](#) prior to submission of the *Proposal for a New Bachelor's or Master's Degree Program*. The letter should include the title, degree designation, CIP code of the program, the anticipated submission date of the proposal, and a brief description of the program. Address the letter to the Assistant Commissioner of the Academic Division of Academic Quality and Workforce.

In completing the proposal, the institution should refer to the document *Standards for Bachelor's and Master's Degree Programs*, which prescribes specific requirements for new degree programs.

This form requires the signatures of: (1) the Chief Executive Officer, certifying adequacy of funding for the new program, the notification of other Texas public institutions of higher education, and adherence to [Texas Education Code \(TEC\) Sections 61.822 through 61.823](#); (2) the Chief Financial Officer, certifying the accuracy of funding estimates for the new program; and (3) a member of the Board of Regents (or designee) certifying Board approval.

Contact: Division of Academic Quality and Workforce, 512-427-6200.

Administrative Information

1. Institution: The University of Texas at El Paso

2. Proposed Program:

Show how the proposed program would appear on the Coordinating Board's Program Inventory (e.g., Bachelor of Business Administration degree with a major in Accounting).

Bachelor of Science in Aerospace and Aeronautical Engineering

3. Proposed CIP Code:

List of CIP Codes may be accessed online at www.txhighereddata.org

14.0201.00

4. Semester Credit Hours Required:

For Bachelor's Degree Programs the number should be 120 SCH (*if the number of SCH exceeds 120 for a Bachelor's Degree program, the institution must submit documentation explaining the compelling academic reason*).

128 SCH – waiver request documentation is submitted

5. Location and Delivery of the Proposed Program:

Provide the location of instruction and how the proposed program will be delivered to students (*e.g., face-to face to students on the main campus in Lubbock*).

Instructed on the main campus in El Paso, face-to-face

6. Administrative Unit:

Identify where the program would fit within the organizational structure of the university (*e.g., Department of Electrical Engineering within the College of Engineering*).

Department of Mechanical Engineering within the College of Engineering

7. Program Description:

Describe the proposed program and the educational objectives.

The proposed Aerospace Engineering program at the University of Texas at El Paso seeks to prepare students for careers in aerospace, aeronautical and defense systems engineering and related disciplines. Successful achievement of this objective will be met if:

- The majority of our graduates obtain meaningful employment in the aerospace or related industry after graduation
- After five years most graduates are working in engineering
- After five years most graduates have achieved their initial career goals and advanced their careers, i.e. promotion, pursuit of an advanced degree, etc.
- All graduates feel well served by the education they received at UTEP.

The program will consist of a largely common initial two years with the current B.S. in Mechanical Engineering degree program at UTEP but have course, laboratory and project experiences in the last two years of the curriculum that prepare students in

- Aerodynamics,
- Propulsion,
- Aerostructures,
- Aerospace dynamics and controls, and
- Aerospace systems engineering and design

Unique focus of the program: defense, small satellite, propulsion systems, exploration vehicles, autonomous systems, hypersonics.

8. Proposed Implementation Date:

Provide the date that students would enter the proposed program (MM/DD/YYYY).

08/24/2020

9. Institutional and Departmental Contacts:

Provide contact information for the person(s) responsible for addressing any questions related to the proposal.

1. Name: Jack Chessa, Ph.D.

Title: Chair of Mechanical Engineering Department

E-mail: jfchessa@utep.edu

Phone: (915) 747-6900

2. Name:

Title:

E-mail:

Phone:

10. Notification to Area Institutions:

Provide a copy of the notification sent to area institutions.

The institution proposing the new bachelor's or master's degree program must notify all public institutions of higher education within 50 miles of the teaching site of their intention to offer the program at least 30 days prior to submitting their request to the Coordinating Board. If objections occur, the proposing institution must resolve those objections prior to submitting the request to the Coordinating Board. If the proposing institution cannot resolve the objection(s), and the institution wishes to submit the proposed program, the proposing institution may request the assistance of the Assistant Commissioner of Academic Quality and Workforce to mediate the objections and determine whether the proposing institution may submit the proposed program. No new program will be approved until all objections are resolved.

Proposed Bachelor's or Master's Degree Program Information

I. Need

A. Job Market Need

The proposed Bachelors of Science in Aerospace and Aeronautical Engineering will seek to place graduates in the general area of aeronautical, aerospace, satellite systems, missiles and defense systems.

An aerospace engineer may find themselves working in design, project management, systems test, sales, parts distribution, data administration or field inspection. Possible job titles include Aerospace Engineer, Systems Engineer, Test Engineer, and Tool and Equipment Designer. Some aerospace engineers will work in national defense that will require the top security clearance.

Most graduate aerospace engineers will initially do technical work in the field with the possibility of transitioning to project and program management with more years of on-the-job experience. Most of these engineers will be employed by aerospace products or service providers, such as Lockheed Martin, Boeing, Raytheon, Airbus, United Launch Alliance, General Dynamics, Northrop Grumman, and Rolls Royce. Also, of interest for the proposed program is the emerging area of commercial space with companies such as Blue Origin, SpaceX, Bigelow Aerospace, Virgin Galactic, Sierra Nevada Space Systems, Orbital Sciences Corp. Some aerospace engineers will be employed by the federal government, engineering consultation firms and university-based science research and development programs, such as NASA, AFOSR, ONR, JPL, MDA, or DARPA.

Historically the aerospace engineering job market has been subject to a rather cyclical hiring profile, but typically averaging in the 4% to 6% annual growth in employment. Commercial and Defense markets have typically had differing growth and expansions due to the different market forces in these sectors. Currently, for the near term, both commercial and defense aerospace engineering has been high.

From the defense side, this growth has been driven by an increase in defense systems spending that saw reduction after the 2008 recession as well as previously realized "peace-dividends". Emerging threats such as hypersonic missile systems and non-symmetric threats have changed the need for aerospace engineers who typically are specialized in the areas of hypersonics systems design, test, and computations.

The total aerospace engineering job outlook is projected for 2% growth over the next decade, (2018-2028 Bureau of Labor Statistics). This is in contrast to the projected 5% growth between 2016 and 2026 by BLS. This is lower than the 5% average growth predicted in the total engineering sector. This decline is attributed to the reduction in aerospace engineers involved directly in the manufacturing sector. This area is being reduced due to automation and advanced manufacturing processes. This downturn is expected to be near-term, and the industry is expected to see a rebound with an increase in the commercial space sector¹. The projected growth over the 2016-2026 time period

¹ . "2017 US aerospace and defense sector export and labor market study", Deloitte

by BLS was 5%. Also, new developments in small satellites have greater commercial viability. The growing interest in unmanned aerial systems will also help drive job growth for aerospace engineers. However, growth in research and development activities will be tempered by a projected decline in employment of aerospace engineers in the manufacturing industry. It is widely accepted that the BLS data does not accurately capture the growth in demand for aerospace engineers in emerging areas such as small-satellites as well as in Unmanned Aerial Systems (UAS). A look at the job postings on Indeed.com, LinkedIn, Glassdoor and CareerBuilder include several postings for jobs for aerospace engineers by companies that typically are not included in the BLS dataset for aerospace engineering jobs. These include Google, UBER, and Amazon, for UAS related jobs as well as Amazon and Google for satellite engineers.

Table 1: BLS projected job growth for aerospace engineers over the next decade.

Employment of Aerospace Engineers		Growth 2018-28	
2018	2018 (projected)	Number	Percent
67,200	68,300	1,100	2%

Aerospace engineers are in high demand due to education requirements and an unsaturated job market. Several aerospace firms are currently researching and developing more sustainable and cost-effective technologies. This push in research and development means that companies will be demanding more innovative and hardworking engineers. In addition, the job marked for US citizens is particularly strong.

"The U.S. aerospace and defense sector continues to be one of the top employers in the U.S. economy, even with the five-year decrease in total employment," Tom Captain, vice chairman, Deloitte LLP

"A return to growth will be healthy for innovation, product development and game-changing technology creation – a cornerstone of this industry,"

"seven states accounted for half of all U.S. aerospace and defense sector employees: California, Washington, Texas, Florida, Arizona, Connecticut and Kansas."

U.S. Aerospace and defense industry to add 39,443 in 2016 Large rebound driven by budget cuts and military drawdown over previous administration \$13B added to Pentagon budget in 2016



Figure 1: Near term job growth in the aerospace and defense industry as well as the current employee age distribution. "2017 US aerospace and defense sector export and labor market study", Deloitte study report.

Clearly, there is career diversity for graduates with a degree in aerospace engineering. Aerospace engineers usually are paid at least 54 dollars an hour, which equals about 113,000 dollars per year.

Product category	Imports		% of total A&D	5-year growth	5-year CAGR
	2011	2016			
Civilian aircraft, engines, equipment, and parts	-	-	-	n/a	n/a
Military aircraft, engines, equipment, and parts	\$35,797	\$49,782	81.7%	39.1%	6.8%
Search, detection, and navigation instruments	\$5,716	\$7,646	12.6%	33.8%	6.0%
Missiles, space vehicles, propulsion units, equipment, and parts	\$279	\$581	1.0%	108.3%	15.8%
Small arms, ammunition, and other ordnance and accessories	\$2,664	\$2,131	3.5%	-20.0%	-4.4%
Military armored vehicle, tanks, and tank components	\$932	\$279	0.5%	-70.1%	-21.4%
Ships	\$114	\$501	0.8%	338.6%	34.4%
Total	\$45,502	\$60,919	100.0%	33.9%	6.0%

Figure 2: US aerospace and defense sector imports by product category in 2011 and 2016 (USD millions) data from US Census Bureau.

In addition to the market demand for aerospace engineers there is a lack of diversity in the aerospace engineering degrees awarded as indicated in Table 1. While there has been a considerable increase in the number of aerospace degrees awarded to Hispanic students they still constitute only 11% of the degrees

awarded in spite of 19% of the population being Hispanic. There is still considerable room for improvement in this area. UTEP has the capacity to fill this gap within the next 5-years due to its current student population being 83% Hispanic. In addition, over 95% of the UTEP student population is U.S. citizen or permanent resident. This makes UTEP a prime candidate to produce Hispanic U.S. citizen aerospace engineers

Table 2: Diversity of aerospace degrees conferred from 2018 "Snapshot of Diversity in Degrees Conferred in Engineering", Associate of Public & Land-Grant Universities.

	Aerospace Bachelor's Degrees Conferred		
	2011	2016	5-Year Change
White	2,305	2,504	8.6%
Asian American	344	374	8.7%
Hispanic	220	431	95.9%
African American	94	116	23.4%
Non-U.S. Resident	246	302	22.8%

Texas is the state with the second largest number of aerospace engineering positions. Currently, there are approximately 6,770 aerospace engineering positions in Texas.

B. Existing Programs

There are currently three aerospace engineering programs in the state of Texas. These are at Texas A&M College Station, The University of Texas at Austin, and at The University of Texas at Arlington. Letourneau University offers a mechanical aeronautical technicians' program, but this program's graduates would be competing for significantly different employment than graduates from the proposed program as well as the graduates from the three mentioned aerospace engineering programs. New Mexico State University (NMSU) offers a B.S. degree in Aerospace Engineering. NMSU is located 47 miles from El Paso in Las Cruces, NM. As shown in Figure 1, the nearest aerospace program in Texas is 576 miles away from the UTEP campus.

UT Austin

Degrees offered: B.S., M.S and PhD in Aerospace and Aeronautical Engineering
Undergraduate Enrollment: 670
B.S. degrees awarded (2019): 106
Employment Breakdown: 75% find jobs in industries such as space, aeronautics, consulting and energy, while 20% go to graduate school.

UT Arlington

Degrees offered: B.S., M.S and M.Eng in Aerospace Engineering

Undergraduate Enrollment: 220
B.S. degrees awarded (2019): 54
Employment Breakdown: 80% find jobs in industries such as space, aeronautics, consulting and energy, while 20% go to graduate school.

Texas A&M College Station

Degrees offered: B.S., M.S and Ph.D. in Aerospace Engineering
Undergraduate Enrollment: 824
B.S. degrees awarded (2019): 193
Employment Breakdown: 75% find jobs in industries such as space, aeronautics, consulting and energy, while 25% go to graduate school.

The enrollment and B.S. degrees conferred for each of the above programs is given in Table No. 3. The state graduates approximately 350 aerospace engineers a year. When this number is compared to the number of projected aerospace and defense job openings (Fig 1), and considering the significant aerospace engineering economy in Texas the need for additional B.S. Aerospace Engineers is a reasonable position.

Table 3: List of enrollment and number of B.S. degrees conferred for all aerospace programs in the state of Texas.

	2014		2015		2016		2017		2018		2019	
	Enrollment	Degrees Conferred	Enrollment	Degrees Conferred	Enrollment	Degrees Conferred	Enrollment	Degrees Conferred	Enrollment	Degrees Conferred	Enrollment	Degrees Conferred
U. T. Arlington												
U.T. Austin	556	105	542	103	572	109	620	110	654	97	666	106
Texas A&M	604	100	590	135	642	106	703	145	786	156	824	193

While the proposed program is an aerospace program we will have a focus on some of the emerging aerospace technologies such as UAS, hypersonics and small spacecraft systems that are not always the primary focus of most classic aerospace engineering programs. This is particularly aligned with the current large aerospace employers in Texas. These include Lockheed Martin, NASA, and Blue Origin as well as some of the smaller commercial space companies.

The current aerospace programs in Texas have a student to faculty ratio of about 20:1 which is often considered the tipping point for programs that are near maximum capacity. In particular, the programs at A&M and Austin carry a large graduate student load. These indicators would seem to suggest that there is capacity for an additional program in Texas. Also, considering the lack of proximity to these existing programs to UTEP we will serve a region and demographic that is quite different from the existing aerospace programs in Texas.

C. Student Demand

The Mechanical Engineering Department at UTEP has had a very strong emphasis on aerospace and aeronautical engineering for the past decade. As a result, a culture of the existing students to this area has been developed. A significant percentage (typically 30% to 40%) of our mechanical engineering graduates will be placed in the aerospace industry. This emphasis has naturally filtered through to our program outreach and recruitment efforts. The local community that we currently draw from is strongly aware of the Mechanical Engineering program's strength in these areas. This has caused a significant interest locally for our current mechanical engineering program, as evidenced by its over 40% enrollment growth in the past five years. In parallel, there has been a consistent demand from the high schools that we recruit from for an aerospace degree; this is the single most common feedback we receive from our recruiters. This can be attributed to 1) the general interest in aerospace 2) the program's current strength in this area, and 3) the recent national emphasis on space-exploration and commercialized space.

The proposed program will have a strong emphasis on some of the emerging high-visibility activities in the aerospace area. These include 1) unmanned aerial systems, 2) small satellites and, 3) lunar, cislunar and Mars exploration vehicles and systems. Having the program focus on this area will give a high degree of marketability and demand from high school students as well as potential employers. This combination will provide strong demand for this program over the next five to ten years.

In parallel, the department plans to develop the program to have a reputation for developing highly marketable aerospace engineers with a focus on U.S. citizens. This will keep a constant demand for incoming students as well as employers in the long term.

D. Enrollment Projections

Table 4 provides the estimated cumulative headcount and full-time student equivalent (FTSE) enrollment for the first five years of the proposed aerospace B.S. program. This program will partner with the existing mechanical engineering program, and it is expected that mechanical engineering students will take several of the courses in the aerospace curriculum.

Table 4: Enrollment Projections

	Year 1	Year 2	Year 3	Year 4	Year 5
Total New Students	50	75	65	100	100
Attrition	0	0	15	20	30
Cumulative Headcount	50	125	185	280	370

FTSE	50	125	185	280	370
Graduates	0	5	15	25	50

E. Student Recruitment

Plans to recruit students are realistic and based on evidence of student demand and unmet need in similar programs in Texas. Indicate if the proposed program and its discipline are projected to have a special attraction for students of a particular population. Describe general recruitment efforts and admission requirements. Describe plans to recruit, retain, and graduate students from underrepresented groups to the proposed program.

The university recruits heavily from the El Paso area, but there is also effort to expand the recruitment geography to include other economically underserved regions in Texas. The department and university have a very active retention strategy. We are in the process of contracting a recruiter in Texas. Aerospace has been a highly requested degree from the local high schools.

II. Quality

A. Degree Requirements

The degree requirements of the proposed program are given in the following section. The general SCH requirements are given in Table 5. The program's request of an exemption for the 120 SCH requirement is provided separately.

Table 5: Semester Credit Hour Requirements by Category

Category	Semester Credit Hours	Clock Hours
General Education Core Curriculum (<i>Bachelor's degree program only</i>)	42	
Required Courses	56	
Prescribed Electives	30	
Electives	0	
Other (<i>Specify, e.g., internships, clinical work</i>)	(if not included above)	
TOTAL	128	

B. Curriculum

The proposed Aerospace Engineering program at The University of Texas at El Paso seeks to prepare students for careers in aerospace engineering and related disciplines. Successful achievement of this objective will be met if:

- The majority of our graduates obtain meaningful employment in the aerospace or related industry after graduation
- After five years most graduates are working in engineering
- After five years most graduates have achieved their initial career goals and advanced their careers, i.e. promotion, pursuit of an advanced degree, etc.
- All graduates feel well served by the education they received at UTEP.

The program will consist of a largely common initial two years with the current B.S. in

Mechanical Engineering degree program at UTEP but have course, laboratory and project experiences in the last two years of the curriculum that prepare students in

- Aerodynamics,
- Propulsion,
- Aerostructures,
- Aerospace dynamics and controls, and
- Aerospace systems engineering

The program will have a unique focus on: defense, small satellite, propulsion systems, exploration vehicles, autonomous systems, and hypersonics. These emerging areas will be in high demand in the next decade and beyond. These niche areas will be balanced with the classic aerospace foundation so that students have a maximum degree of marketability. The aerospace program, as with the current mechanical engineering program, will have a high percentage of US citizens. This is to serve the demand of employers in our targeted aerospace and defense sectors. The mechanical engineering program is approximately 75% US citizen and it is expected that the proposed aerospace program will contain a similar, or greater, percentage of US citizens.

In addition to the above focus, the program will be a significant generator of Hispanic aerospace engineers. This program will have national preeminence for conferring the largest number of aerospace engineering B.S. degrees in the country. The current mechanical engineering undergraduate program is over 82% Hispanic serving and it is fully expected that the aerospace engineering program will have a similar demographic makeup. If the enrollment projections hold this will mean that this program will increase the number of Hispanic aerospace engineering degrees conferred annually by 25%.

The required, prescribed and elective courses were chosen to give a necessary foundation in aerospace engineering as well as provide maximum flexibility within the existing mechanical engineering program. This allows students to easily transition between the two programs for the first two years of either program. The third year's classes are selected to give a broad overview of the essential cornerstones of aerospace and aeronautical engineering. These include: aerodynamics; propulsion; structures; dynamics and controls; and aerospace systems engineering.

The electives are organized to support a concentration based organization which 1) supports the unique focus of the proposed aerospace program and 2) gives significant flexibility for the students to help them progress efficiently through the program. There is a focus on aerospace design experiences as well as relevant lab experiences.

A student can transfer a maximum of 66 semester hours, limited to courses in the first and second year of the degree plan, from two-year junior and community colleges. A maximum of 100 semester hours of courses is transferable from accredited U.S. colleges and universities. Transfer credit for engineering courses is restricted to ABET-accredited curricula or is awarded on the basis of departmental recommendation and only for first and second-year courses. Third or fourth-year courses are allowed to be transferred into the degree plan provided they are from quality accredited institutions. Transfer students might be required to take competency exams and/or take specified courses that the department feels they must have to establish the quality of their degree.

The students initiate the transfer credit process through the department. The transfer request is initiated with the Level Two Advisors with subsequent approval from the UPD and the department chair. At this point, the transfer request is sent to the college advising staff for approval, then to the registrar's office to be officially entered into the Banner system. The academic records of all transfer students are reviewed by the College of Engineering to determine eligibility for admission into an engineering program. International students must meet the additional requirement of an overall minimum GPA of 3.0 in mathematics, chemistry, physics, and engineering for all institutions attended.

Only transfer credit approved by both the department and the college can be applied toward an undergraduate degree in engineering. Transfer credit evaluation should be completed when the student transfers to the college or before completion of the lower-division requirements.

The department has the authority to evaluate only courses with a MECH prefix. Students wishing to transfer courses in other colleges, such as MATH, PHYS, CHEM, are evaluated by the corresponding department that administers that course. Texas Common Core curriculum courses may not be substituted and must satisfy the approved curriculum with the exception of Texas Core Curriculum courses that are pre-approved as equivalent. This approval is facilitated by the Texas Higher Education Coordinating Board who publish a list of all approved courses from Texas universities. This is mandated by state law.

Identify any alternative learning strategies, such as competency-based education, that may increase efficiency in student progress in the curriculum. If no such policies are in place to improve student progression through a program, provide an explanation.

Table 6: Curriculum of the proposed aerospace B.S. program

University Core Curriculum		
Complete the University Core Curriculum requirements		42
Aerospace Engineering (Other Requirements) (All courses require a grade of C or better.)		
Required Courses: Some of these are in the Core.		
MATH 1411	Calculus I	4
MATH 1312	Calculus II	3
MATH 2313	Calculus III	3
MATH 2326	Differential Equations	3
CHEM 1105	Laboratory for CHEM 1305	1
CHEM 1305	General Chemistry	3
PHYS 2420	Introductory Mechanics	4
Select one of the following:		3
MATH 3323	Matrix Algebra	
MATH 3335	Applied Analysis I	
STAT 3320	Probability and Statistics	
MATH 4326	Linear Algebra	

MATH 4329	Numeric Analysis	
MATH 4336	Applied Analysis 2	
Select one of the following:		4
CHEM 1306 & CHEM 1106	General Chemistry and Laboratory for General Chemistry	
PHYS 2421	Introductory Electromagnetism	
Select one of the following:		3
PHYS 2325	Survey of Modern Physics	
PHYS 3351	Analytical Mechanics I	
PHYS 4348	Fundamentals of Acoustics	
Aerospace Engineering Major		
Required Courses:		
MECH 1305	Graphic & Design Fundamentals ^C	3
MECH 1321	Mechanics I-Statics ^C	3
MECH 2322	Mechanics of Materials ^C	3
MECH 2311	Intro to Thermal-fluid Sci ^C	3
MECH 2103	Engineering Computations ^C	1
MECH 2342	Electro Mechanical Systems ^C	3
MECH 2340	Mechanics II - Dynamics ^C	3
MECH 3352	Engineering Analysis	3
AERO 4364	Aerospace Communication	3
AERO 2331	Aerospace Materials	3
AERO 2131	Aerospace Materials Laboratory	1
AERO 3312	Aerodynamics I	3
AERO 3323	Aerospace Structures I	3
AERO 3343	Systems Modelling and Control	3
AERO 4322	Aerospace Propulsion	3
AERO 4366	Aerospace Senior Design ³	3
AERO 4365	Aerospace Systems Engineering	3
Select two of the following: Laboratory Experience		
MECH 3123	Solid Mechanics Lab (MECH 2322+)	1
MECH 3113	Thermo-fluid Lab (MECH 2311+)	1
MECH 3103	Mechatronics Lab (MECH 2342+)	1
Concentration Electives ¹ : Must take 3 from one Concentration		9
Aircraft Concentration:		
AERO 4311	Flight Dynamics and Control	3
AERO 4312	Aircraft Design	3
AERO 4313	Aerospace Structures II	3
AERO 4319	Special topics in Aeronautics	3
Launch Vehicles and Missiles Concentration		

AERO 4331	Aerodynamics II (Supersonic and Hypersonic)	3
AERO 4332	Hypersonic Vehicle Design	3
AERO 4335	Structural Dynamics	3
AERO 4339	Special Topics in Hypersonics	3
Satellite Concentration		
AERO 4351	Orbit and Attitude Dynamics	3
AERO 4353	Space Environments	3
AERO 4355	Space Mission Design	3
AERO 4359	Special Topics in Astronautics	3
Technical Electives: ^{2:}		6
Total Hours		128

^C Course requires a grade of C or better

¹ Must declare a concentration and take three classes from the declared concentration area
Must be an aerospace class from outside your declared aerospace concentration area

² or from any MECH 4XXX course.

³ Must be in the last full semester and have a 2.0 GPA or better in major.

^C Course requires a grade of C or better

¹ Must declare a concentration and take three classes from the declared
concentration area

² Must be from outside your declared aerospace concentration area

³ Must be in the last full semester and have a 2.0 GPA or better in major.

C. Strategic Plan and Marketable Skills

The university's strategic plan is given at the following link on the THECB web site.
<http://www.thecb.state.tx.us/DocID/PDF/10860.PDF>

The proposed program with its focus on defense systems is consistent with the university's plan in focusing on national defense and border security as well as supporting the university's strategic objectives in strengthening research, engineering and emerging technologies. In particular, the university's strategic plan focuses on the W.M. Keck Center for 3D Innovation and the Center for Space Exploration & Technology Research. Both of which are significant supporting centers for the proposed program. Many of the core and supporting faculty in the aerospace program are also in one of these centers.

The W.M. Keck Center for 3D Innovation is home to state-of-the-art advanced manufacturing, reverse-engineering, and computer-aided design technologies. In addition to conducting university-level research, the Keck Center provides services to medical and manufacturing industries in the region and to others who need solutions to design and fabrication problems.

The Center for Space Exploration & Technology Research promotes research and education in propulsion and energy engineering, actively conducting a wide range of analytical, experimental and computational research in energy and propulsion engineering with a particular interest in green propulsion, in-situ resource utilizations, space structures, clean power generation, solar energy and carbon dioxide sequestrations.

Historically, the mechanical engineering department has had a strong placement of graduates into the aerospace and defense sector. Presently, the undergraduates are well aware of the marketability of an aerospace degree. The demand of the aerospace engineers is documented in the previous sections.

D. Faculty

The proposed program shall have a sufficient number of core and support faculty to teach the scope of the discipline, consistent with similar programs in the state and nation. At least 50 percent of the faculty full-time equivalent (FTE) supporting a bachelor's or master's program must be Core Faculty.

Complete Table 7 to provide information about Core Faculty. Add an asterisk (*) before the name of the individual who will have direct administrative responsibilities for the proposed program. Core Faculty are full-time tenured and tenure-track faculty who would teach 50 percent or more in the proposed program or other individuals integral to the proposed program. Modify the table as needed.

Table 7: Core faculty

Name and Rank of Core Faculty	Highest Degree and Awarding Institution	Courses Assigned in Program	% Time Assigned to Program
<i>e.g.: Robertson, David Assoc. Prof</i>	<i>PhD. in Molecular Genetics Univ. of Wisconsin-Madison</i>	<i>MG200, MG285 MG824 (Lab Only)</i>	<i>50%</i>
*Chessa, Jack, Assoc. Professor	PhD Mechanical Engineering, Northwestern University		50%
Abed Methaq, Assoc. Professor of Practice	PhD Civil Engineering, University of Baghdad		50%
Castellanos, Alejandra, Asst. Professor	PhD Civil and Environmental Engineering, University of Wisconsin-Madison		75%
Choudhuri, Ahsan, Professor	PhD Mechanical Engineering, University of Oklahoma, Norman		50%
Everett, Louis; Professor	PhD Mechanical Engineering, Texas A&M		50%
Flores-Abad, Angel; Research Asst. Professor	PhD Mechanical Engineering, NMSU		50%
Greig, Amelia; Asst. Professor	PhD Physics, Australian National University		75%
Khan, Arifur; Research Asst. Professor	PhD Electrical Engineering, Kyushu Institute of Technology		50%
Lin, Yirong; Assoc. Professor	PhD Mechanical Engineering, Arizona State University		50%
Love, Norman; Assoc. Professor	PhD Mechanical Engineering, University of Oklahoma, Norman		50%
McGee, Michael; Senior Research Assoc. Prof	PhD Pardee Rand Graduate School		50%
Quintana, Joel; Research Assistant Professor	PhD Electrical and Computer Engineering, UTEP		50%
Rahman, Md Mahamudur; Assist. Professor	PhD Mechanical Engineering, Drexel University		50%
Shafirovich, Evgeny; Professor	PhD Chemical Physics, Institute of Chemical Physics, Russian Academy of Sciences		50%
Stewart, Calvin; Professor	PhD Mechanical Engineering, University of Central Florida		50%
New Faculty in Year 21			75%
New Faculty in Year 22			75%
New Faculty in Year 23			75%
New Faculty in Year 24			75%

New Faculty in Year 25			75%

Complete Table 8 to provide information about Support Faculty. Support Faculty are other tenured or tenure-track faculty from related disciplines, adjunct faculty, and graduate teaching assistant or assistant instructor who meets SACSCOC minimum requirements and serves as the instructor of record for a course. Modify the table as needed.

Table 8: Support faculty

Name and Rank of Support Faculty	Highest Degree and Awarding Institution	Courses Assigned in Program or Other Support Activity	% Time Assigned to Program
<i>e.g.: Robertson, David Assoc. Prof</i>	<i>PhD. in Molecular Genetics Univ. of Wisconsin-Madison</i>	<i>MG200, MG285 MG824 (Lab Only)</i>	<i>10%</i>
Benedict, Barry; Professor	PhD Civil Engineering, University of Florida		15%
Bronson, Arturo; Professor	PhD Metallurgical Engineering, Ohio State University		15%
Cedillos Baraza, Omar; Asst. Professor of Practice	PhD Materials, Imperial College London		15%
Espalin, David; Asst. Professor	PhD Mechanical Engineering, The University of Texas at El Paso		15%
Kumar, Vinod; Assoc. Professor	PhD Mechanical Engineering, Rice University		15%
Mallahzadeh, Hossein; Assoc. Professor of Practice	PhD Offshore Engineering, University of Liverpool		15%
Medina, Francisco; Associate Professor	PhD Material Science and Engineering, The University of Texas at El Paso		15%
Ramana, Chintalapalle; Professor	PhD Materials Science and Applied Physics, Sri Venkateswara University		15%
Terrazas, Cesar; Research Asst. Professor	PhD Materials Science and Engineering, The University of Texas at El Paso		15%
Wicker, Ryan; Professor	PhD Mechanical Engineering, Stanford University		15%

E. Library Resources

The current library holdings and journal subscriptions are sufficient to support a B.S. in aerospace engineering program.

The UTEP Library has been designed to provide University and community users with a modern and efficient facility for study and research. The building houses over 900,000 books, including 200,000 government documents, and more than one million microforms.

The present Library opened October 12, 1984. It features a unique Bhutanese architecture, as do many of the buildings on campus. The light and airy atrium of the Library houses one of the University's collections of tapestries sewn by Buddhist monks in Thimphu, the capital of Bhutan. The Library building has 275,000 square feet, with six floors and a book capacity of 1.2 million volumes.

Special facilities include 65 faculty studies, 192 graduate study carrels, and a small auditorium. There are over 200 works of art on permanent display, including paintings by Tom Lea and over 100 original drawings by Jose Cisneros.

Robert L. Stakes, Associate VP for Information Resources and Planning, and Director of the Library, heads the UTEP Library Administration. Luke Jastrzebski, the Associate University Librarian for Public Services and Reference, and Nancy Hill, the Associate University Librarian for Technical Services, assist with daily administration of their respective areas.

The Director is responsible for the administration of a centralized campus library with a collection of over one million volumes, a growing base of electronic resources, media, microforms, and special collections, an annual budget of \$7.45 million, and a staff of 22 professional librarians, 46 classified staff, and 111 student assistants. The UTEP Library is open seven days a week, and provides many services for faculty and students beyond collections and databases, including Digital Commons, the institutional repository that includes articles, images, technical reports, hosted journals, dissertations and theses authored by the UTEP community.

There are two Research Librarians, part of the professional staff, assigned to work with the departments in the College of Engineering. Specifically, their assigned areas are listed, by degree program, in **Table 9**.

Table 9: *Research Librarians for Engineering Programs*

Program	Librarian Assigned
Civil Engineering	Debjani Mukhopadhyay
Computer Science	Les Arms
Electrical Engineering	Debjani Mukhopadhyay
Industrial Engineering	Les Arms
Mechanical Engineering	Debjani Mukhopadhyay
Metallurgical & Materials Engineering	Debjani Mukhopadhyay

The library, as part of its operating budget makes acquisitions, in print and electronically, for the programs in the College of Engineering. The library has begun a Demand Driven Acquisitions program, so expenditures for a specific department may fluctuate from year to year, based on the demand experienced during the previous academic year. As reflected in the table, the UTEP Library has experienced an increasing reliance on

journals, rather than books. Also, note that e-books used by the departments within the College of Engineering are charged to a separate fund, so are included in the table.

F. Facilities and Equipment

The program will highly utilize the existing mechanical engineering undergraduate facilities. We will develop a composites manufacturing space as well as an aircraft design studio. The expense of this infrastructure development is included in Table 11. These estimates were developed with support from the university's facilities planning department.

G. Accreditation

This program will seek accreditation from ABET. The specific accreditation sought will be under the Engineering Accreditation Commission (EAC) for aerospace and similarly named programs.

H. Evaluation

Currently, the Mechanical Engineering Department has a very effective and sustainable assessment process for its ABET accreditation. The site evaluators for ABET have acknowledged how strong this assessment process is. The Mechanical Engineering Department will mirror the same assessment process for the Aerospace program.

The program will also track the admission statistics, enrollment, attrition through non-enrollment and change of major. This will allow the program to assess the students' success in progression through the program. These metrics will be directly tracked by the program staff. From this data, student retention can be ascertained as well as the assessment of the cohort progression through the program. To assess the program's success post-graduation, the student placement as well as exiting senior surveys will be used. This data is currently tracked for all undergraduate programs by the university's Center for Institutional Evaluation, Research and Planning (CIERP). The information will give insight into the students' preparation for the job market as well as any changes in the market demand.

The evaluation and monitoring tasks are performed using UTEP's extensive web-based Student Information Management Systems (Goldmine and Banner). In addition, several staff members are trained in the submission of Web-Reports that allow for data queries on the registrar's student database. These systems are supported by the university's information technology groups and directly feed the data from the registrar's office to both Goldmine and Banner. Advisors have access to Banner and Goldmine and most staff are trained on the use of Web-Reports. These systems give information on individual students and also allow for the collection of data to assess the program's effectiveness in moving students through the program, and provides enrollment and retention numbers.

Using certification tools from the Goldmine system, advisors and students can generate comprehensive reports of courses taken, courses pending, grades and GPA. The

Mechanical Engineering Department will also maintain a comprehensive physical file for each student enrolled in the program.

These systems largely automate and ensure that the following are satisfied:

- Students are only enrolling in the courses for which they have the proper pre-requisites.
- Students who were taking the required pre-requisite classes in the previous semester have successfully completed the pre-requisite classes with the necessary grade.
- Students are maintaining appropriate GPAs.

The University's registration system automatically enforces prerequisite restrictions for each course. Students cannot register in a course unless all of its prerequisites are met. If a student is currently enrolled in a course that is the prerequisite of a course for the next semester, the department provides an 'interim prerequisite' waiver during the advising process for a timely completion of the registration process. These 'Interim prerequisites' are tracked and monitored as well. At the beginning of the semester the registration system automatically checks the prerequisite compliance for each course and automatically drops the student if the student failed to meet the prerequisites. Apart from these types of interim waiver, the department has a policy to not provide prerequisite waivers.

The department also internally audits these 'interim prerequisite' waivers as well as the satisfaction of the course prerequisites. This is to ensure that the system is in-fact operating as we expect.

All Aerospace Engineering students will have an advising hold each semester and must successfully complete mandatory online advising delivered through Blackboard®, the University's LMS, in order to be allowed to register for the following semester; a short quiz is administered through Blackboard® to ensure that the students are proficient in the advising material. Students can, and are encouraged to, use the Career Advising and Program Planning's (CAPP) degree plan evaluator system to track their progress through the degree.

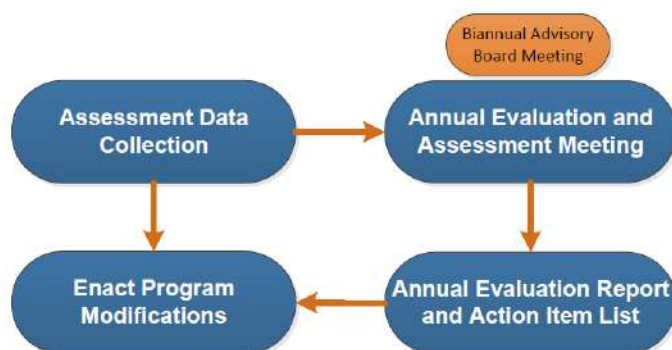


Figure 3: Illustration of the aerospace program assessment loop for the first five-years of the program.

III. Costs and Funding

A. Five-Year Costs and Funding Sources Summary

Table no. 11 gives a summary of the five-year program costs and the associated funding sources. These estimates were developed in coordination with the College of Engineering's Business Center as well as with the Office of the Provost. This effort was also developed in conjunction with the university's budget process. The personnel will be housed in the Mechanical Engineering Department and will support both programs as indicated in Tables 7 and 8. The reallocated funds are infrastructure development costs and personnel funds from the Mechanical Engineering program for shared faculty and infrastructure development. It is also assumed that there will be students that transition from mechanical engineering to aerospace engineering and these students are not included in the designated tuition and fees as well as the formula funding estimates.

Table 10: Five-year program costs and funding summary.

Five-Year Costs		Five-Year Funding	
Personnel ¹	\$3.6M	Reallocated Funds	\$500k
Facilities and Equipment	\$750k	Anticipated New Formula Funding ³	\$2.6M
Library, Supplies, and Materials	\$150k	Designated Tuition and Fees	\$5.2M
Other ²	\$100k	Other ⁴	\$2.5M
Total Costs	\$4.6M	Total Funding	\$13M

1. Report costs for new faculty hires, graduate assistants, and technical support personnel. For new faculty, prorate individual salaries as a percentage of the time assigned to the program. If existing faculty will contribute to program, include costs necessary to maintain existing programs (e.g., cost of adjunct to cover courses previously taught by faculty who would teach in new program).
2. Specify other costs here (e.g., administrative costs, travel).
3. Indicate formula funding for students new to the institution because of the program; formula funding should be included only for years three through five of the program and should reflect enrollment projections for years three through five.
Report other sources of funding here. In-hand grants, "likely" future grants, and special item funding can be included.

B. Signature Page

The signature page must be signed by the required institutional officials and board of regents.

V. Additional Distance Education Delivery Consideration

A. Adherence to *Principles of Good Practice*

Submit the *Certification Form* or provide a statement from the Chief Academic Officer certifying adherence to *Principles of Good Practice* as well as adherence to Coordinating Board distance education rules and policies.

B. Administrative Oversight and Structure

Identify the person/office directly responsible for the overall management of the proposed program. Identify other responsibilities of the person/office with primary responsibility and any modifications in responsibility made to accommodate the program. Describe the ways in which the delivery method will affect the proposed program.

C. Collaborative Arrangements

There will be no other programs involved in the delivery of this program other than the mechanical engineering program at UTEP where the aerospace engineering program will be administratively housed.

D. Program Differences

The program will not be employing any delivery modes other than face-to-face learning.

The program will be in full compliance with the university's Center for Accommodations and Support Services (CASS) to ensure that students who need such accommodations will be properly served.

Signature Page

- 1. Adequacy of Funding and Notification of Other Institutions** – The Chief Executive Officer shall sign the following statements:

I certify that the institution has adequate funds to cover the costs of the proposed program. Furthermore, the proposed program will not reduce the effectiveness or quality of existing programs at the institution.

I certify that my institution has notified all public institutions within 50 miles of the teaching site of our intention to offer the proposed program at least 30 days prior to submitting this request. I also certify that if any objections were received, those objections were resolved prior to the submission of this proposal.

I certify that my institution will adhere to Texas Education Code (TEC), Sections 61.822 through 61.823, requiring my institution to accept and apply to the proposed program Core Curriculum and Field of Study courses in transfer.

Chief Executive Officer

Date

- 2. Accuracy of Financial Estimates** – The Chief Financial Officer shall sign the following statement:

I certify that the estimated costs and sources of funding presented in the proposal are complete and accurate.

Chief Financial Officer

Date

- 3. Board of Regents or Designee Approval** – A member of the Board of Regents or designee shall sign the following statement:

On behalf of the Board of Regents, I hereby certify that the proposed program is appropriate for the mission of this institution and the Board of Regents has approved the proposed program.

Board of Regents (Designee)

Date

Aerospace Engineering Request for Waiver of the 120-Credit-Hour Maximum

Executive Summary. The Aerospace degree program within the College of Engineering is seeking a waiver to the 120-credit-hour rule. Four degree programs in the COE (Civil, Electrical, Mechanical, and Metallurgical) currently have 128 hour programs. This request is based on the three major points summarized below. A full discussion of these points is given in subsequent pages.

1. We are very mindful of the two major reasons for the recommendation of a Maximum Credit Hour law. The Texas Comptroller's report ("Texas Performance Review: Disturbing the Peace" (<http://www.window.state.tx.us/tpr/tpr4/tpr4.html>, Volume 2, Chapter 1, Section 11, published in December 1996) cited "credit hour creep" and cost of education as the two major reasons for recommending that a law limiting the credit hours be created. We address these two issues by:
 - a. monitoring our own degree plans' credit hours by comparison with regional and leading institutions, as well as our accreditation agency; and
 - b. aiding our engineering students with cost of education by subsidizing the cost of student projects and equipment, and helping them secure paid internships and scholarships. Last year alone, 43 undergraduate students in the Mechanical Engineering Department obtained paid internships related to Aerospace Engineering. This number is expected to grow once an Aerospace Engineering program is adopted.
2. The aforementioned Texas Comptroller's report recommended that the law provide exceptions "approved only after considering criteria such as accreditation and licensing standards, employment trends in various professions." Squeezing an Aerospace Engineering degree into 120 hours will only be detrimental to our ability to grow. More detail is given in subsequent pages, but the issues are
 - a. UTEP Mission: we will no longer be able to educate regional students that can compete in national or international markets because they will lack nearly 3 full specialty Aerospace courses;
 - b. ABET (the Accreditation Board for Engineering and Technology): an inability to become accredited will mean a dearth of recruiters and UTEP graduates with no possibility of employment as professional engineers;
 - c. Departmental Industrial Advisory Boards: mandated by ABET standards, the groups soundly reject the idea of squeezing the curriculum;
 - d. the FE exam (the first licensing exam for Professional Engineers): cutting technical hours from the degree program will negatively impact the "pass rate" on the FE exam, which is currently not where the legislature mandates that it should be; and
 - e. the PE exam (the second licensing exam for Professional Engineers): the Texas Board of Professional Engineers is currently listening to groups that indicate that even at 128 credit hours, engineers probably need at least 30 more technical course hours to be competent.

- f. The curriculum was designed with a two-year common core between mechanical engineering and aerospace engineering. This was to allow students the most flexibility in choosing the degree most appropriate for their career path. Reducing the number of classes will negatively impact this flexibility and have the unintended consequence of actually delaying graduation.
3. The Legislative Act (HB 1172) was ultimately approved, and the law itself was added by the 79th legislature, effective June 18, 2005. So while the original recommendation in the Comptroller's document was set up to provide exceptions "limited in number and approved only after considering criteria such as accreditation and licensing standards, employment trends in various professions," the law itself reads that 120 credit hours may be exceeded only if the institution determines "that there is a compelling academic reason." The law is written in the Texas Education Code, Title3 (Higher Education), Chapter 61 (Texas Higher Education Coordinating Board), [SECTION 61.0515. \(SEMESTER CREDIT HOURS REQUIRED FOR BACCALAUREATE DEGREE\)](#). We, in the Department of Mechanical Engineering, the College of Engineering and the University who are proposing the new Aerospace Curriculum, feel that there is a compelling academic reason, as outlined in #2 above. Specifically, we cannot produce graduates that are technically competent (or recognized as such) with less than 128 credit hours. Furthermore, we are meeting the spirit of the law (in reducing time to degree) by:
 - a. Introducing basic engineering courses that can be taken by students in a timely manner by eliminating excessive prerequisites;
 - b. Implementing a new advising structure ensuring students make timely progress;

In summary, the next sections provide detailed explanations of the reasons cited above. Specifically, we cannot ensure the academic soundness of a degree plan at 120 credit hours, which will place our program with fewer hours than required by most universities that we use to help assess our quality. We respectfully request a waiver from the 120-credit-hour-maximum rule based on the arguments outlined above.

Program Requirements From ABET

The Accreditation Board for Engineering and Technology (ABET) places certain criteria on an accredited engineering program. This section describes these criteria as applicable to Aerospace Engineering. ABET lists 8 general criteria and 2 program specific criteria for Aerospace Engineering. This section describes these in the same order.

ABET General Criteria 1 – Students

ABET requires student performance to be evaluated and monitored to foster success in attaining student outcomes. As this has no direct impact on the number of credit hours required for a degree it will not be further discussed here.

ABET General Criteria 2 - Program Educational Objectives

ABET requires published program educational objectives (PEOs) that are consistent with the mission of the institution, the needs of the program's various constituencies, and these criteria. The Mechanical Engineering Department, the host department for Aerospace, recognizes the unique mission of UTEP and desires to prepare students for a range of objectives. Some students desire to attend graduate school and the Department wants to prepare them for the graduate school of their choice. Other students choose to enter practice and the Department wants to prepare them to be highly competitive in the workplace. One way this is accomplished is to provide sufficient electives so the students can tailor their education for the objective that is right for them. The Aerospace program will require 15 hours of electives; 9 of which are taken from a single concentration providing depth of knowledge and 6 of which provide the broad knowledge required to sufficiently understand the complexities of aircraft and spacecraft.

ABET General Criteria 3 – Student Outcomes

The third general criteria is to have documented student outcomes (SOs) that support the program educational objectives (PEOs). ABET student outcomes are outcomes numbered (1) through (7), plus any additional outcomes that may be articulated by the program.

- 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.*

Further discussion demonstrating the mapping of proposed Aerospace Engineering courses to ABET SO requirements is in Section: Mapping Of ABET Criteria to AERO Curriculum.

ABET General Criteria 4 – Continuous Improvement

ABET requires documented processes for assessing and evaluating the extent to which the student outcomes are being attained. As this has no direct impact on the number of credit hours required for a degree it will not be further discussed here.

ABET General Criteria 5 – Curriculum

The curriculum requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The program curriculum must provide adequate content for each area, consistent with the student outcomes and program educational objectives, to ensure that students are prepared to enter the practice of engineering. The curriculum component as stated by ABET for Engineering courses is:

- (a) a minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program*
- (b) a minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design, and utilizing modern engineering tools.*
- (c) a broad education component that complements the technical content of the curriculum and is consistent with the program educational objectives.*
- (d) a culminating major engineering design experience that 1) incorporates appropriate engineering standards and multiple constraints, and 2) is based on the knowledge and skills acquired in earlier course work.*

Further discussion demonstrating the mapping of proposed Aerospace Engineering courses to ABET Curriculum requirements is in Section: Mapping Of ABET Criteria to AERO Curriculum.

ABET General Criteria 6-8 – Faculty, Facilities, Institutional Support

ABET requires faculty, facilities and institutional support be demonstrated and adequate to support the proposed program. As this has no direct impact on the number of credit hours required for a degree it will not be further discussed here.

ABET Program Specific Criteria – Aerospace Engineering

In addition to the general criteria listed above for all engineering programs, ABET imposes the following additional criteria on Aerospace Engineering programs.

1. Curriculum

Aeronautical engineering or similarly named engineering programs must include the following curricular topics in sufficient depth for engineering practice: aerodynamics, aerospace materials, structures, propulsion, flight mechanics, and stability and control.

Astronautical engineering or similarly named engineering programs must include the following curricular topics in sufficient depth for engineering practice: orbital mechanics, space environment, attitude determination and control, telecommunications, space structures, and rocket propulsion.

*Aerospace engineering programs or similarly named engineering programs, which combine aeronautical engineering and astronautical engineering topics, must include all curricular topics in sufficient depth for engineering practice in one of the areas—*aeronautical engineering**

or astronautical engineering as described above—and, in addition, similar depth in at least two topics from the other area.

The major design experience must include topics appropriate to the program name.

2. Faculty

The program must demonstrate that faculty members teaching upper-division courses have an understanding of current professional practice in the aerospace industry.

Mapping Of ABET Criteria to AERO Curriculum

While preparing the proposed AERO curriculum, the faculty looked carefully at how the lower and upper level courses each contribute to the ABET criteria for Student Outcomes (SOs), the relation of core, supporting, and program specific courses to ABET criteria for Curriculum, the UTEP core curriculum requirements, and the expectations of prospective employers in industry.

Required Courses

Relation of program specific courses to ABET SOs are outlined for lower division required courses in Table 1 and upper division required courses in Table 2. The concentration courses are outlined in Table 3, and the laboratory technical electives outlined in Table 4.

The most technical of the ABET SOs, being 1, and 6, are well covered by the required classes and concentration courses. ABET SOs 5, and 7, related to somewhat covered by required classes, but assistance from core courses brings the requirements to the level needed. The broader SOs that address societal components, being 2, 3, and 4 require support from core curriculum courses. For example, *SO 4 - ethical and professional responsibility* can be partially covered using humanities however the specifics of Professional Ethics as stipulated in the Code of Ethics published by the Society of Professional Engineers can only be guaranteed coverage in Engineering courses. Likewise the core curriculum contributes to *SO 3 – effective communication*; however the specifics of technical data communication such as in presentation graphics and presentation of mathematical information must be covered through engineering courses. The technical courses cover the technical solution aspect of *SO 2 - 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*, but the core courses are required to inform of the health, safety, global, cultural, social, environmental, and economic factors.

Table 1: Lower Division Required Courses

Course Number	Short Name	Credit Hours	Course Type	Program Outcome						
				(1)	(2)	(3)	(4)	(5)	(6)	(7)
MECH 1305	Graphic and Design Fundam...	3	R	✓	✓					
MECH 1321	Mechanics I – Statics	3	R	✓	✓				✓	
MECH 2322	Mechanics of Materials	3	R	✓				✓	✓	
AERO 2231	Aerospace Materials	3	R	✓						✓

AERO	2131	Aerospace Materials Lab	1	R,L		✓	✓		✓	✓	
MECH	2340	Mechanics II – Dynamics	3	R	✓	✓			✓	✓	✓
MECH	2311	Intro to Thermo-Fluid Sci...	3	R	✓	✓				✓	
MECH	2103	Engineering Computations	1	R	✓						✓
MECH	2342	Electro Mechanical Systems	3	R	✓			✓	✓	✓	

R = Required, L=Lab, C=Concentration, E=Elective

Table 2: Upper Division Required Courses

Course Number		Short Name	Credit Hours	Course Type	Program Outcome						
					(1)	(2)	(3)	(4)	(5)	(6)	(7)
MECH	3352	Engineering Analysis	3	R	✓		✓		✓	✓	
AERO	3312	Aerodynamics I	3	R	✓						✓
AERO	3343	System Modelling and Control	3	R	✓				✓	✓	
AERO	3323	Aerospace Structural Analysis	3	R	✓					✓	✓
AERO	4322	Aerospace Propulsion	3	R	✓	✓	✓	✓			✓
AERO	4364	Aerospace Communications	3	R	✓	✓		✓			✓
AERO	4365	Aerospace Systems Engin...	3	R	✓	✓	✓	✓	✓	✓	✓
AERO	4366	Aerospace Senior Design	3	R	✓	✓	✓	✓	✓	✓	✓
		Concentration Courses	9	R	<i>depends on course – see table 3</i>						
		Lab Electives	2	R	<i>depends on course – see table 4</i>						
		Technical Electives	6	R	<i>depends on course</i>						

R = Required, L=Lab, C=Concentration, E=Elective

Table 3: Concentration Courses

Course Number		Short Name	Credit Hours	Course Type	Program Outcome						
					(1)	(2)	(3)	(4)	(5)	(6)	(7)
AERO	4311	Flight Dynamics and Control	3	C,A	✓		✓			✓	✓
AERO	4312	Aircraft Design	3	C,A	✓	✓		✓	✓		
AERO	4313	Aerospace Structures II	3	C,A	✓		✓			✓	✓
AERO	4331	Aerodynamics II	3	C,H	✓					✓	
AERO	4332	Hypersonic Vehicle Design	3	C,H	✓	✓		✓	✓		
AERO	4335	Structural Dynamics	3	C,H	✓		✓			✓	
AERO	4351	Orbit and Attitude Dynamics	3	C,S	✓				✓	✓	
AERO	4353	Space Environments	3	C,S	✓		✓				✓
AERO	4355	Space Mission Design	3	C,S	✓	✓		✓	✓		

C=Concentration, A=Air, H=Hypersonics, S=Space

Table 4: Elective Lab Courses

Course Number		Short Name	Credit Hours	Course Type	Program Outcome						
					(1)	(2)	(3)	(4)	(5)	(6)	(7)
MECH	3123	Solid Mechanics Lab	1	L,E		✓	✓		✓	✓	
MECH	3113	Thermo-fluid Lab	1	L,E		✓	✓		✓	✓	
MECH	3103	Mechatronics Lab	1	L,E		✓	✓		✓	✓	

Basic Math and Science

The ABET Criteria 5(a) requires a minimum of 30 semester credit hours of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program in addition to technical program courses. Table 5 outlines the basic math and science components for the aerospace engineering program, most of which are pre-requisite knowledge for program specific courses. The total credit hours come to 31 due to the addition of lab classes to suit the “experimental experience” ABET requirement.

Table 5: Basic Math and Science Courses – ABET Criteria 5(a)

Course Number		Short Name	Credit Hours
MATH	1411	Calculus I	4
PHYS	2420	Introductory Mechanics	4
MATH	1312	Calculus II	3
CHEM	1305	Chemistry I	3
CHEM	1105	Chemistry I Lab	1
MATH	2313	Calculus III	3
MATH	2326	Differential Equations	3
		Math/Science Elective (inc labs)	10
		TOTAL CREDIT HOURS	31

Core Curriculum

The core curriculum requirements as applied to the aerospace program are shown in Table 6. The courses marked with an asterisk are courses that can be counted both toward the core curriculum requirements and basic math and science requirement, totaling 9 credit hours. ABET Criteria 5(c) does not specify a number of credit hours for core courses, so the 42 credit hours chosen match the UTEP core curriculum specification.

Table 6: Core Curriculum Courses - ABET Criteria 5(c)

Course Number		Short Name	Credit Hours	Core Area
RWS	1301	Rhetoric & Composition I	3	English Composition
RWS	1302	Rhetoric & Composition 2	3	English Composition
MATH	1411	Calculus I	3*	Mathematics
PHYS	2420	Introductory Mechanics	3*	Life and Physical Sciences
CHEM	1305	Chemistry I	3*	Life and Physical Sciences
		Humanities Elective	3	Language, Philos. and Culture
		Creative Arts Elective	3	Creative Arts
HIST	1301	History of US to 1865	3	American History
HIST	1302	History of U.S. Since 1865	3	American History
POLS	2310	Introduction to Politics	3	Political Science
POLS	2311	American Gov and Poli...	3	Political Science
CE	2326	Econ for Engrs & Scientists	3	Social and Behavioral Science
COMM	1302	Business and Prof Comm...	3	Component Area Option
UNIV	1301	Foundations of Engineering	3	Component Area Option
		TOTAL CREDIT HOURS	42	

Denotes dual applicability to ABET Math and Science Requirement

Culminating Design Experience

ABET Criteria 5(d) requires a culminating major engineering design experience. This is satisfied by the two required courses AERO4365: Aerospace Systems Engineering and AERO 4366: Aerospace Senior design, each worth 3 credit hours and held in successive semesters in senior year.

Most other highly regarded engineering schools use a minimum of 6 credit hours for the culminating design experience. There is little probability that ABET could be convinced that the culminating design experience can be covered in less than 6 credits, especially since the extra requirements placed on Aerospace Engineering in the Program Specific Criteria require the ability to work in one concentration area but with familiarity in a second concentration.

Program Specific Requirements

For the aeronautics concentration (including hypersonics) ABET program specific requirements mandate as a minimum courses in 1) aerodynamics, 2) aerospace materials, 3) structures, 4) propulsion, 5) flight mechanics, and 6) stability and control

For the astronautics concentration ABET program specific requirements mandate as a minimum courses in 1) orbital mechanics, 2) space environments, 3) attitude determination and control, 4) telecommunications, 5) space structures, and 6) rocket propulsion.

As the broad name of the course is “Aerospace Engineering” the requirement is to offer all courses from one concentration and at least two courses from the other concentration. This requires a minimum of 8 program specific topics. To be able to cover material in these topics to the level expected by key industry companies the Mechanical Engineering Department has conferred with stakeholders over the content of the proposed Aerospace Engineering degree program, each topic requires at least 6 credit hours. An initial 3 credit hour introductory course is taken at the sophomore or junior level on fundamental concepts, tools, and techniques, followed by an in-depth, application and design focused 3 credit hour senior level course. However, due to the use of concentrations and electives in the degree course targeting specific careers and employers, it is assumed that the student will not need to take all advanced level courses. A minimum of 4 advanced level topic courses will be adequate to produce UTEP Aerospace Engineering graduates highly sought after and successful in industry. This requires 36 credit hours of program specific technical courses.

In addition to the courses directly related to ABET program specific requirements, an additional 22 units of general engineering knowledge courses are required as pre-requisites. Required topics include but are not limited to engineering (technical) drawings, materials, structural mechanics (statics and dynamics), thermodynamics, and fluid mechanics. These are the 22 credit hours of MECH (Mechanical Engineering) courses listed in Tables 1 and 2 that satisfy these requirements.

Credit Hour Summary

Table 7 summarizes all the required course credit hours needed for the Aerospace Engineering program at UTEP. Our conclusions are that all of the courses in the 128 hour curriculum play a

vital role in meeting ABET requirements, and there is no room to eliminate hours. An ABET accredited, 120 hour Aerospace Engineering curriculum, is tenuous at best.

Table 7: Credit Hour Summary

Credit Hours	Course Type	Criteria / Mandate
42	Core Curriculum	UTEP Core / ABET 5(c)
22 (+9)	ABET Science and Math (+9 units core)	ABET 5(a)
6	Culminating Design Experience	ABET 5(d)
22	General Engineering	ABET 5(b)
36	Aerospace Program Specific Courses	ABET 5(b) / Industry

Comparison of UTEP Aerospace Engineering to Similar Programs

A comparison is presented between the proposed BS Aerospace Engineering degree at UTEP (128 hours) with existing programs across selected US universities, highlighting the need for more than 120 credit hours to remain competitive among graduate abilities.

Consider the Texas Flagship schools. Texas A&M College Station requires a minimum of 128 and UT Austin requires 127. Both admit essentially the upper 10% of the high school graduating class. In contrast, UTEP proudly admits students with less preparation. Regardless of how much better UTEP faculty are compared to the flagship research faculty, it would be unrealistic to think UTEP can use fewer hours to matriculate students who begin less prepared and are more academically challenged.

Impact of 120 Hours on the UTEP Mission

To meet UTEP's unique mission, Aerospace Engineering has educational objectives that are diverse to meet student needs. As such it is imperative to provide a flexible curriculum that can be tailored to individual needs. The department allocates 30 hours for electives to tailor the education to the individual.

If forced into a 120 hour curriculum, all the course material is locked into satisfying the minimum conditions for ABET and there is no ability to tailor the program for students with diverse dreams. We will not be able to serve our students the way they deserve. Additionally, our graduates will be entering industry without the expected skills of graduate aerospace engineers, going against the UTEP mission of producing high quality, industry ready graduates.

Regulations For 120 Hours Should Not Apply to Engineering

The Texas Higher Education Coordinating Board in its rules suggests that engineering programs require more than 4 years to complete. I call your attention to rule 21.129 "Forgiveness of Loans" in (1b) "... if the degree is in architecture, engineering, or any other program determined

by the Board to require more than four years to complete; ...” Two other states that have mandated 120 hour curricula are Florida and Arizona. In both states, the law specifically excludes Engineering programs. These legislators understand that Engineering is considered a five year program by most educators.

Arguably the motivation for the State to mandate 120 hour curricula is twofold: (1) to fight credit hour creep, the slow increase of credits over time and (2) to combat the rising cost of education. The Mechanical Engineering Department (the host for the Aerospace program) has over the years squeezed hours from the curriculum. Second, the Department has worked hard to provide money for tuition to students. The research active faculty provide more jobs for undergraduates than ever before. The Department has also worked hard to bring fees down and be much more fiscally responsible than ever before.

Impact on UTEP's Stature

In conclusion, because our graduates are high quality and are predominately from underrepresented groups in engineering they find national employment. The department is proud of this. This good market position gives UTEP Mechanical Engineering high visibility. We expect the same for the proposed Aerospace program. Because of this visibility, it is absolutely imperative that the department maintain high quality. If our quality slips, the visibility will very quickly build a national reputation for poor performance. Once earned, this bad reputation will be very difficult to overcome.

Making the mistake of cutting hours and allowing quality to slip, will seriously reduce the amount of and in-depth coverage of engineering concepts needed by our UTEP Aerospace Engineering students. A death blow to UTEP Aerospace Engineering is a death blow to the many students for whom UTEP is their only ticket to success. We respectfully request permission to have an Aerospace curriculum with 128 hours.

APPENDIX A: Proposed Aerospace Degree Plan

Year	Semester I			Hrs	Semester II			Hrs
Freshman	MECH	1305	Graphic and Design Fundamentals +	3	MECH	1321	Mechanics I – Statics + (MATH 1411+ PHYS 2420+)	3
	RWS	1301	Rhetoric & Composition I +	3	HIST	1301	History of US to 1865 +	3
	MATH	1411	Calculus I +	4	RWS	1302	Rhetoric & Composition 2 + (RWS 1301+)	3
	PHYS	2420	Physics I (MATH 1411 is CO requisite)	4	MATH	1312	Calculus II + (MATH 1411+)	3
	UNIV	1301	Foundations of Engineering +	3	CHEM CHEM	1305 1105	Chemistry I +	4
				17				16
Sophomore	MECH	2322	Mechanics of Materials + (MECH 1321+)	3	MECH	2340	Mechanics II – Dynamics + (MECH 1321+)	3
	MATH	2313	Calculus III + (MATH 1312+)	3	MECH	2311	Introduction to Thermo-Fluid Science + (MATH 1312+)	3
	AERO	2331	Aerospace materials + (CHEM 1305+, CHEM 1105 +)	3	MECH	2103	Engineering Computations +	1
	AERO	2131	Aerospace Materials Lab + (MECH 1305+)	1	MECH	2342	Electro Mechanical Systems + (MATH 1312+)	3
	HIST	1302	History of US since 1865 +	3	CE	2326	Engineering Economics +	3
			Science Elective + (see NOTE 1)	4	MATH	2326	Differential Equations +	3
				17				16
Junior			Laboratory Experience (see NOTE 2)	1			Laboratory Experience (see NOTE 2)	1
	MECH	3352	Engineering Analysis (MECH 2351+)	3	COM M	1302	Business and Professional Communication +	3
	AERO	3312	Aerodynamics I	3	AERO	3343	System Modelling and Control (MATH 2326 +, MECH 2342 +, MECH 2340 +)	3
	AERO		Concentration Course I (See NOTE 5)	3	AERO	3323	Aerospace Structural Analysis (AERO 2331 +, MECH 2322 +)	3
	POLS	2310	Introduction to Politics +	3	AERO		Concentration Course II (See NOTE 5)	3
	MATH		Math Elective + (see NOTE 3)	3			Science/Math Elective + (see NOTE 4)	3
				16				16
Senior	AERO		Aero concentration III (NOTE 5)	3	AERO	4366	Aerospace Senior Design	3
	AERO	4322	Aerospace Propulsion (MECH 2311 +, CHEM 1305 +)	3	AERO	4364	Aerospace Communications (MECH 2342 +)	3
			Technical Elective (See Note 6)	3			Technical Elective (NOTE 6)	3
	AERO	4365	Aerospace Systems Engineering (CE 2326 +, COMM 1302 +)	3	POLS	2311	American Government and Politics	3
			Humanities Electives +	3			Visual and Performing Art Elective	3
				15				15
Total 128 Credit hrs								

BS in Aerospace and Aeronautical Engineering

Return to: [Degree Programs](#)

The Aerospace and Aeronautical Engineering curriculum is designed for students who desire to enter the aerospace or related industry or to pursue advanced studies in these areas. The curriculum provides a broad range of courses in the areas of aerodynamics, aerospace structures and aerospace and aeronautic vehicle design.

Vision

The Aerospace and Aeronautical Engineering Program strives to graduate aerospace engineers of the highest quality and to conduct state-of-the-art research.

Mission

The Aerospace and Aeronautical Engineering program at The University of Texas at El Paso seeks to prepare students for careers in aerospace engineering and related disciplines. Successful achievement of this objective will be met if:

- The majority of our graduates obtain meaningful employment in the aerospace or related industry after graduation
- After five years most graduates are working in engineering
- After five years most graduates have achieved their initial career goals and advanced their careers, i.e. promotion, pursuit of advanced degree, etc.
- All graduates feel well served by the education they received at UTEP.

The program will consist of a largely common initial two years with the current B.S. in Mechanical Engineering degree program at UTEP but have course, laboratory and project experiences in the last two years of the curriculum that prepare students in

- Aerodynamics,
- Propulsion,
- Aerostructures,
- Aerospace dynamics and controls, and
- Aerospace systems engineering

Admission Requirements

There are no additional admission requirements to the program above those of admission to the University of Texas at El Paso and to eligible to take MATH 1411 Calculus I or equivalent.

Degree Requirements

The degree requires 128 SCH which includes:

- 1) completion of the university core curriculum (42 SCH)
- 2) 56 SCH of prescribed courses,
- 3) 30 SCH of engineering electives

The degree plan is given in detail in below

University Core Curriculum		
Complete the University Core Curriculum requirements		42
Aerospace Engineering (Other Requirements) (All courses require a grade of C or better.)		
Required Courses: Some of these are included in the core.		
MATH 1411	Calculus I	4
MATH 1312	Calculus II	3
MATH 2313	Calculus III	3
MATH 2326	Differential Equations	3
CHEM 1105	Laboratory for CHEM 1305	1
CHEM 1305	General Chemistry	3
PHYS 2420	Introductory Mechanics	4
Select one of the following:		3
MATH 3323	Matrix Algebra	
MATH 3335	Applied Analysis I	
STAT 3320	Probability and Statistics	
MATH 4326	Linear Algebra	
MATH 4329	Numeric Analysis	

MATH 4336	Applied Analysis 2	
Select one of the following:		4
CHEM 1306 & 1106	General Chemistry and Laboratory for General Chemistry	
PHYS 2421	Introductory Electromagnetism	
Select one of the following:		3
PHYS 2325	Survey of Modern Physics	
PHYS 3351	Analytical Mechanics I	
PHYS 4348	Fundamentals of Acoustics	
Aerospace Engineering Major		
Required Courses:		
MECH 1305	Graphic & Design Fundamentals ^C	3
MECH 1321	Mechanics I-Statics ^C	3
MECH 2322	Mechanics of Materials ^C	3
MECH 2311	Intro to Thermal-fluid Sci ^C	3
MECH 2103	Engineering Computations ^C	1
MECH 2342	Electro Mechanical Systems ^C	3
MECH 2340	Mechanics II - Dynamics ^C	3
MECH 3352	Engineering Analysis II	3
AERO 2131	Aerospace Materials Laboratory	1
AERO 2331	Aerospace Materials	3
AERO 3323	Aerospace Structures I	1
AERO 3312	Aerodynamics I	3
AERO 3343	Systems Modelling and Control	3
AERO 4364	Aerospace Communication	3
AERO 4322	Aerospace Propulsion	3
AERO 4366	Aerospace Senior Design ³	3
AERO 4365	Aerospace Systems Engineering	3

Select two of the following: Laboratory Experience		
MECH 3123	Solid Mechanics Lab (MECH 2322+)	1
MECH 3113	Thermo-fluid Lab (MECH 2311+)	1
MECH 3103	Mechatronics Lab (MECH 2342+)	1
Concentration Electives ¹ : Must take 3 from one Concentration		9
Aircraft Concentration:		
AERO 4311	Flight Dynamics and Control	3
AERO 4312	Aircraft Design	3
AERO 4313	Aerospace Structures II	3
AERO 4319	Special topics in Aeronautics	3
Launch Vehicles and Missiles Concentration		
AERO 4331	Aerodynamics II (Supersonic and Hypersonic)	3
AERO 4332	Hypersonic Vehicle Design	3
AERO 4335	Structural Dynamics	3
AERO 4339	Special Topics in Hypersonics	3
Satellite Concentration		
AERO 4351	Orbit and Attitude Dynamics	3
AERO 4353	Space Environments	3
AERO 4355	Space Mission Design	3
AERO 4359	Special Topics in Astronautics	3
Technical Electives ²		6
Total Hours		128

^c Course requires a grade of C or better

¹ Must declare a concentration and take three classes from the declared concentration area

Must be an aerospace class from outside your declared aerospace

² concentration area or from any MECH 4XXX course.

³ Must be in the last full semester and have a 2.0 GPA or better in major.

COURSE ADD

All fields below are required

College : Engineering

Department : Aerospace Engineering

Rationale for adding the course:

New Bachelor of Science in Aerospace Engineering

All fields below are required

Subject Prefix and # AERO 2131

Title (29 characters or fewer): Aerospace Materials Lab

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

This course will focus on the implementation of different manufacturing methods in the design process for aerospace structures. The students will be introduced to the fundamentals of the machining trade and different types of manufacturing, such as Additive, Subtractive methods and composite manufacturing (Vacuum Assisted Resin Transfer Molding and hand lay-up).

Contact Hours (per week): Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☐ A Lecture | ☐ H Thesis |
| ☒ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
MECH 1305	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Sophomore
Major	Aerospace Engineering

**The University of Texas at El Paso
College of
Department of
Syllabus**

Course Prefix and Number: AERO 2131

Course Title: Aerospace Materials Lab

Credit Hours: 1

Prerequisite Courses: MECH 1305 with C or better

Course Description: This course will focus on the implementation of different manufacturing methods in the design process for aerospace structures. The students will be introduced to the fundamentals of the machining trade and different types of manufacturing, such as Additive Manufacturing, Subtractive methods and composite manufacturing (Vacuum Assisted Resin Transfer Molding and hand lay-up).

Learning Outcomes:

1. Students will learn to use machine shop conventional machines (lathe, mills and CNC), hand tools, additive manufacturing methods and composite manufacturing.
2. Students will learn the complete design process and manufacturing of Aerospace parts.
3. Students will improve their writing skills through technical essay assignments summarizing laboratory procedures and demonstrations.

Required Materials: Machinery's Handbook by Erik Oberg (any edition)

Course Schedule:

1. Machine shop safety
2. Hand tools
3. Measuring instruments
4. Machine shop conventional machines (lathe, mill and CNC)
5. Subtractive manufacturing
6. Fasteners, tapping and threads
7. Tolerance and clearance
8. Additive manufacturing
9. Composite manufacturing

COURSE ADD

All fields below are required

College : Engineering

Department : Aerospace Engineering

Rationale for adding the course:

New Bachelor of Science in Aerospace Engineering

All fields below are required

Subject Prefix and # AERO 2331

Title (29 characters or fewer): Aerospace Materials

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

This course is designed to introduce the students to basic materials science with an emphasis on properties and how they are influenced by thermal and mechanical treatments. The students will be able to relate the microstructure of a material to its properties, and understand the effects of the environment on materials and the possible failure modes of structures. The students will be provided with demonstrations of various processes in the laboratory

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
CHEM 1305	C	N
CHEM 1105	C	N

Corequisite Course(s):	Equivalent Course(s):

Restrictions:	
Classification	Sophomore
Major	Aerospace Engineering

The University of Texas at El Paso
College of
Department of
Syllabus

Course Prefix and Number: AERO 2331

Course Title: Aerospace Materials

Credit Hours: 3

Prerequisite Courses: CHEM 1305 and CHEM 1105 both with C or better.

Course Description: This course is designed to introduce the students to basic materials science with an emphasis on properties and how they are influenced by thermal and mechanical treatments. The students will be able to relate the microstructure of a material to its properties, and understand the effects of the environment on materials and the possible failure modes of structures. The students will be provided with demonstrations of various processes in the laboratory.

Learning Outcomes:

1. Students will recognize how the internal structure of a material (both at the micro and macro levels) controls the mechanical properties.
2. Students will be able to explain how dislocation motion is responsible for permanent deformation in metals and how the ability to undergo slip influences the mechanical properties of the material.
3. Students will realize their ability to control the mechanical properties of materials through a variety of processes and the implications on materials selection and design.
4. Students will improve their writing skills through technical essay assignments summarizing laboratory procedures and demonstrations.

Required Materials: The Science and Engineering of Materials, 7th Edition by Donald R. Askeland and Wendelin J. Wright, Cengage Learning.

Course Schedule:

- | | |
|--|----------------------|
| 1. Atomic structure | 11. Corrosion |
| 2. Structural imperfections | 12. Polymers |
| 3. Atomic movement | 13. Failure Analysis |
| 4. Mechanical testing | 14. Ceramics |
| 5. Solidification | 15. Polymers |
| 6. Solid solutions | 16. Failure Analysis |
| 7. Mechanical working and heat treatment | |
| 8. Dispersion strengthening | |
| 9. Phase transformations | |
| 10. Metals and alloys | |

COURSE ADD

All fields below are required

College : Engineering

Department : Aerospace Engineering

Rationale for adding the course:

New Bachelor of Science in Aerospace Engineering

All fields below are required

Subject Prefix and # AERO 3312

Title (29 characters or fewer): Aerodynamics 1

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

This course builds on the student's background in Fluid Mechanics to deal primarily with flows (low-speed and high-speed) relevant to aerospace applications, with particular emphasis on components related to an airplane. Both inviscid and viscous flows will be considered in the analysis of airfoils, wings, nozzles, and diffusers.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
AERO 2311	C	N

Corequisite Course(s):	Equivalent Course(s):

Restrictions:	
Classification	Junior
Major	Aerospace Engineering

**The University of Texas at El Paso
College of Engineering
Department of Mechanical Engineering
Syllabus**

Course Prefix and Number: AERO 3312

Course Title: Aerodynamics I

Credit Hours: 3

Prerequisite Courses:

MECH 2311: Introduction to Thermo-Fluid Science with C or better

Course Description:

This course builds on the student's background in Fluid Mechanics to deal primarily with flows (low-speed and high-speed) relevant to aerospace applications, with particular emphasis on components related to an airplane. Both inviscid and viscous flows will be considered in the analysis of airfoils, wings, nozzles, and diffusers.

Learning Outcomes:

- Formulate and apply and apply conservation equations to predict forces and performance of airfoils (lift and drag)
- Perform analysis of flow for wings, nozzles, and diffusers
- Compute the change in pressure, temperature, and density across shock and expansion waves
- Compute aircraft velocity using pressure measurements from a Pitot tube

Required Materials: All required materials will be provided

Course Schedule:

Weeks 1-2	Introduction	Dimensional analysis, lift, drag, vector operations, conservation equations (mass, momentum, and energy)
Weeks 3-4	Inviscid Flows	Bernoulli's equation, sources, sinks, vortex, lift past a circular cylinder
Weeks 5-6	Incompressible Flows	Viscous flows, boundary layer flows, laminar and turbulent flows, airfoil theory (symmetric and cambered),
Weeks 7-8	Wing Theory	Induced drag, Helmholtz Theorems, Prandtl's lifting-line theory
Weeks 9-11	Compressible Flows	Thermodynamics review, compressibility equations, normal shock, oblique shock, and expansion waves
Weeks 12-13	External Flows	Flow over wedges and cones, shock interactions, Prandtl -Meyer expansion waves, flow through nozzles and diffusers
Weeks 14-15	Experimental Techniques	Flow visualization (Schlieren, shadowgraph), wind tunnel, pitot-tube, pressure distribution around a circular cylinder, introduction to propulsion systems of airplanes

COURSE ADD

All fields below are required

College : Engineering

Department : Aerospace Engineering

Rationale for adding the course:

New Bachelor of Science in Aerospace Engineering

All fields below are required

Subject Prefix and # AERO 3323

Title (29 characters or fewer): Aerospace Structures I

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

This course is designed to introduce the students to the analysis and the design of aerospace structures. Review concepts of stress, strain, and equations of elasticity. Plane stress and plane strain. Applications to aerospace structural elements including thin-walled beams with open and closed section, unsymmetrical bending of wing sections, torsion of skin-stringer and multi-cell sections, flexural shear in open and closed sections, Shear Center and failure criteria.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
AERO 2331	C	N
MECH 2322	C	N

Corequisite Course(s):	Equivalent Course(s):

Restrictions:	
Classification	Junior
Major	Aerospace Engineering

The University of Texas at El Paso
College of
Department of
Syllabus

Course Prefix and Number: AERO 3323

Course Title: Aerospace Structures I

Credit Hours: 3

Prerequisite Courses: AERO 2331 and MECH 2322 both with C or better.

Course Description: This course is designed to introduce the students to the analysis and the design of aerospace structures. Review concepts of stress, strain, and equations of elasticity. Plane stress and plane strain. Applications to aerospace structural elements including thin-walled beams with open and closed section, unsymmetrical bending of wing sections, torsion of skin-stringer and multi-cell sections, flexural shear in open and closed sections, Shear Center and failure criteria.

Learning Outcomes:

1. Students will have an understanding of the concepts involved in the theory of linear elasticity.
2. Students will understand stresses and deformations in rods, trusses, beams and thin plates.
3. Students will understand stress analysis methods for thin-walled structures subjected to bending and torsion.
4. Students will understand how to apply these analysis methods and results to real-world aerospace structural problems.

Required Materials: (Any of the following books)

Aircraft Structures for Engineering Students, T.H.G. Megson, Butterworth, 5th Ed.
Introduction to Aerospace Structural Analysis, D.H. Allen and W. Haisler

Course Schedule:

1. Review of statics: FBD, Determinate and indeterminate, stress, strain and Hooke's Law in 2-D and 3-D solids.
2. Cauchy's formula. Compatibility equations for strains. Transformation of stresses and strains, Mohr's circles. 2-D and 3-D principal stresses and strains.
3. Axial Loading, Torsion, Bending of beams, Sectional properties. Simple and multi-axial bending. Beam deflections.
4. Plane stress, plane strain. Airy stress function. Simple elasticity solutions.
5. Shear stresses in solid beams and thin-walled structures of open and closed sections.
6. Shear flow analysis and Shear center.
7. Materials for aerospace and aircraft structures: Materials selection and evaluation.

COURSE ADD

All fields below are required

College : Engineering

Department : Aerospace Engineering

Rationale for adding the course:

New Bachelor of Science in Aerospace Engineering

All fields below are required

Subject Prefix and # AERO 3343

Title (29 characters or fewer): Systems Modelling and Contro

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

The course will provide the basis for system modelling in time and frequency domain with an emphasis in aerospace applications. The course will deliver concepts and the best practices for design and implementation of model-based feedback control of SISO systems. The course will include laboratories and project experiences for real-time implementation.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
MATH 2326	C	N
MECH 2340	C	N
MECH 2342	C	N

Corequisite Course(s):	Equivalent Course(s):

Restrictions:	
Classification	Junior
Major	Aerospace Engineering

**The University of Texas at El Paso
College of
Department of
Syllabus**

Course Prefix and Number: AERO 3343

Course Title: Systems Modelling and Control

Credit Hours: 3

Prerequisite Courses: MATH 2326 & MECH 2342 and MECH 2340 all with C or better.

Course Description: The course will provide the basis for system modelling in time and frequency domain with an emphasis in aerospace applications. The course will deliver concepts and the best practices for design and implementation of model-based feedback control of SISO systems. The course will include laboratories and project experiences for real-time implementation.

Learning Outcomes: Upon completion of this course, students will be able to: obtain the dynamic model of aerospace systems in time domain and frequency domain as well as to analyze the system's behavior; design, tune and analyze automatic controllers for SISO systems; and to implement control systems in a simulation environment as well as in real-time applications.

Required Materials:

-Textbook: Nise, Norman S. CONTROL SYSTEMS ENGINEERING. John Wiley & Sons, 8th Edition.

-Laptop

Course Schedule:

- Laplace Transform (depending on if differential equations will be prerequisite)
- Transfer function
- Dynamic Response
- Block diagram representation
- PID Controllers Design Time Domain
- PID Controllers Design in Frequency Domain

COURSE ADD

All fields below are required

College : Engineering

Department : Aerospace Engineering

Rationale for adding the course:

New Bachelor of Science in Aerospace Engineering

All fields below are required

Subject Prefix and # AERO 4311

Title (29 characters or fewer): Flight Dynamics and Controls

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

The course will deliver fundamentals on design, implementations and testing of communications systems in Aerospace applications. The course will provide the participants with fundamentals on digital and analog signal processing, signal losses and attenuation; and will prepare the students to design flight communication systems and ground stations using a variety of instruments.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
AERO 3312	D	N
AERO 3343	D	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Senior
Major	Aerospace Engineering

**The University of Texas at El Paso
College of
Department of
Syllabus**

Course Prefix and Number: AERO 4311

Course Title: Flight Dynamics and Controls

Credit Hours: 3

Prerequisite Courses: AERO 3343 and AERO 3312

Course Description: The course will deliver fundamentals on aircraft flight dynamics, including rotational, linear and nonlinear. The course will also include stability analysis and control design using classical and modern techniques. Besides, the course will use computer simulations to validate the theoretical developments.

Learning Outcomes: Upon completion of this course, students will be able to: derive the equations of motion of aircraft, including aerodynamics forces and moments; design feedback controllers using classical and modern approaches; and simulate and test the aircraft dynamics and control algorithms in a simulation environment.

Required Materials:

-Textbooks:

- Durham, Wayne. Aircraft flight dynamics and control. John Wiley & Sons, 2013.
- Vepa, Ranjan. Flight Dynamics, Simulation, and Control: For Rigid and Flexible Aircraft. CRC Press, 2014.

-Laptop

Course Schedule:

- Rotational Dynamics
- Aerodynamic Forces and Moments
- Nonlinear Flight Dynamics
- Flight Dynamics Linearization
- Aircraft Stability
- Aircraft Classical Feedback Control
- Aircraft Modern Feedback Control

COURSE ADD

All fields below are required

College : College of Engineering

Department : Mechanical Engineering

Rationale for adding the course:

Part of New Bachelor of Aerospace Engineering Degree Plan

All fields below are required

Subject Prefix and # AERO4312

Title (29 characters or fewer): Aircraft Design

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

The design of aircraft follows a distinct process but one that varies widely with vehicle application and requirements. This course introduces the broad aircraft design process including sub-system interactions, then leads students through specific design tasks. These tasks include sizing of structures and control surfaces, wing loading and structural supports, aircraft configuration, weight distribution, and human considerations.

Contact Hours (per week): 3 Lecture Hours 0 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
AERO3323	D	N
MECH3352	D	N
AERO3312	D	N

Corequisite Course(s):	Equivalent Course(s):

Restrictions:	
Classification	Junior, Senior
Major	

**The University of Texas at El Paso
College of Engineering
Department of Mechanical Engineering
Syllabus**

Course Prefix and Number: AERO 4312

Course Title: Aircraft Design

Credit Hours: 3

Prerequisite Courses:

AERO 3323: Structural Analysis

MECH 3352: Engineering Analysis

AERO 3312: Aerodynamics I

Course Description:

The design of aircraft follows a distinct process but one that varies widely with vehicle application and requirements. This course introduces the broad aircraft design process including sub-system interactions, then leads students through specific design tasks. These tasks include sizing of structures and control surfaces, wing loading and structural supports, aircraft configuration, weight distribution, and human considerations.

Learning Outcomes:

- Critically analyze alternative aircraft configurations and design choices
- Apply engineering analysis to the aircraft design process
- Identify requirements data sources for aircraft design and evaluation
- Apply computational analysis and modelling in the aircraft design process

Required Materials: Daniel P. Raymer, 2012, *Aircraft Design: A conceptual approach*, American Institute of Aeronautics and Astronautics Inc., Reston, VA, USA.

Course Schedule:

Week 1-2	Aircraft Design Process History and Overview
Weeks 3-4	Aircraft sizing
Weeks 3-4	Turbine engines, components, thermodynamic cycles; nozzle theory, thermochemistry, afterburners
Weeks 5-7	Aircraft configuration and geometry
Weeks 6-9	Rocket equation, de Laval nozzles, solid rockets, liquid rockets, hybrid rockets, turbomachinery, rocket staging
Week 10-11	Aircraft loading, including wing loading
Weeks 12	Aircraft weight estimates and distribution
Week 13-14	Subsystem integration, including propulsion system, landing gear, and control devices
Week 15	Human factors in aircraft design

COURSE ADD

All fields below are required

College : Engineering

Department : Aerospace Engineering

Rationale for adding the course:

New Bachelor of Science in Aerospace Engineering

All fields below are required

Subject Prefix and # AERO 4313

Title (29 characters or fewer): Aerospace Structures II

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

This course is designed to introduce the students to the analysis and the design of aerospace structures. Bending of plates and shells. Buckling analysis. Energy principles and minimum potential energy. Introduction to the finite element method. Airworthiness and airframe loads. Strength and damage characteristics of ductile, brittle and composite materials. Elements of fracture mechanics and fatigue.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
AERO 3323	D	N

Corequisite Course(s):	Equivalent Course(s):

Restrictions:	
Classification	Senior
Major	Aerospace Engineering

The University of Texas at El Paso
College of
Department of
Syllabus

Course Prefix and Number: AERO 4313

Course Title: Aerospace Structures II

Credit Hours: 3

Prerequisite Courses: AERO 3323 with a D or better.

Course Description: This course is designed to introduce the students to the analysis and the design of aerospace structures. Bending of plates and shells. Buckling analysis. Energy principles and minimum potential energy. Introduction to the finite element method. Airworthiness and airframe loads. Strength and damage characteristics of ductile, brittle and composite materials. Elements of fracture mechanics and fatigue.

Learning Outcomes:

1. Students will be able to analyze shear flow in practical aerospace structures.
2. Students will be able to calculate buckling loads for beams and plates.
3. Students will be able to understand Principle of Minimum Potential Energy and apply the theorem to solve a variety of structural problems.
4. Students will be able to derive finite element equations for truss and beams.

Required Materials: Advanced Strength and Applied Stress Analysis, 2nd ed, Budynas, R.G., McGraw-Hill 1999

Course Schedule:

1. The bending of plates and shells.
2. Buckling analysis for thin structures in compression.
3. Energy principles in linear elasticity: minimum potential energy.
5. Strength and damage characteristics of ductile and brittle metals.
6. Strength and general nature of composite materials.
7. Elements of fracture mechanics and fatigue

COURSE ADD

All fields below are required

College : College of Engineering

Department : Mechanical Engineering

Rationale for adding the course:

Part of New Bachelor of Aerospace Engineering Degree Plan

All fields below are required

Subject Prefix and # AERO4319

Title (29 characters or fewer): Special Topics in Aeronautics

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

Selected topics of current interest in the field of aeronautical engineering.

Contact Hours (per week): 3 Lecture Hours 0 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)

Corequisite Course(s):	Equivalent Course(s):

Restrictions:	
Classification	Junior, Senior
Major	

**The University of Texas at El Paso
College of Engineering
Department of Mechanical Engineering
Syllabus**

Course Prefix and Number: AERO 4319
Course Title: Special Topics in Aeronautics
Credit Hours: 3

Prerequisite Courses: Dependent on the topic.

Course Description:

Selected topics of current interest in the field of aeronautical engineering.

Learning Outcomes:

- Outcomes vary by the instructor and the type of topic presented.
- Students will be able to solve problems in the area of the special topic.

Required Materials: Dependent on the topic.

Course Schedule: Dependent on the topic.

COURSE ADD

All fields below are required

College : College of Engineering

Department : Mechanical Engineering

Rationale for adding the course:

Part of New Bachelor of Aerospace Engineering Degree Plan

All fields below are required

Subject Prefix and # AERO4322

Title (29 characters or fewer): Aerospace Propulsion

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

Operation and design principles of a wide variety of aerospace propulsion systems, including propellers, turbine engines, chemical rockets, electric thrusters, nuclear rockets, and propellant-less and other advanced propulsion concepts. How stored energy is converted to vehicle momentum through gas dynamics processes. Introduction to propulsion system integration and testing, and aerospace mission propulsion system selection.

Contact Hours (per week): 3 Lecture Hours 0 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☒ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
MECH 2311	C	N
CHEM 1305 or equivalent	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Senior
Major	

**The University of Texas at El Paso
College of Engineering
Department of Mechanical Engineering
Syllabus**

Course Prefix and Number: AERO 4322

Course Title: Aerospace Propulsion

Credit Hours: 3

Prerequisite Courses:

MECH 2311: Introduction to Thermo-Fluid Science and CHEM 1305 or equivalent: Chemistry I both with C or better.

Course Description:

Aerospace Propulsion will teach you the operation and design principles of a wide variety of aerospace propulsion systems, including propellers, turbine engines, chemical rockets, electric thrusters, nuclear rockets, and propellant-less and other advanced propulsion concepts. In the process, you will learn how stored energy is converted to vehicle momentum through gas dynamics processes. You will also be introduced to propulsion system integration and testing, and aerospace mission propulsion system selection. By the end of this course you will come away with a strong foundation in all aerospace propulsion concepts.

Learning Outcomes:

- Compare variations in propulsion system designs for atmospheric and in-space aerospace systems
- Differentiate methods for converting stored energy to momentum
- Evaluate propulsion system designs in regards to mission selection
- Analyze how propulsion systems affect other aerospace vehicle subsystems

Required Materials: All required materials will be provided

Course Schedule:

Week 1	History	Historical development of aerospace propulsion systems and concepts
Weeks 2	Propellers	Blade design, piston engines, electric motors, performance and efficiency
Weeks 3-4	Turbines	Turbine engines, components, thermodynamic cycles, nozzle theory, thermochemistry, afterburners
Weeks 5	Hypersonic Engines	Ramjets, scramjets, supersonic and hypersonic flow regimes, shock trains, diverging nozzles,
Weeks 6-9	Rockets	Rocket equation, de Laval nozzles, solid rockets, liquid rockets, hybrid rockets, turbomachinery, rocket staging
Week 10	Chemical thrusters	In-space maneuvering, cold gas thrusters, warm gas thrusters,
Weeks 11-12	Electric Propulsion	Plasma, charged particle motion, electrostatics, electrothermal propulsion, electrostatic propulsion, electromagnetic propulsion
Week 13	Nuclear Propulsion	Nuclear Electric, Nuclear Thermal, Nuclear Ramjets, Environmental Consideration, Safety and Ethics
Week 14	Field Propulsion	Solar sails, Directed energy, Solid-state air-breathing, latest developments in aerospace propulsion
Week 15	Selection	Mission specific selection, sizing, integration, testing

COURSE ADD

All fields below are required

College : College of Engineering

Department : Mechanical Engineering

Rationale for adding the course:

Part of New Bachelor of Aerospace Engineering Degree Plan

All fields below are required

Subject Prefix and # AERO4331

Title (29 characters or fewer): Aerodynamics II

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

The behavior of fluids at high speeds varies significantly from low speed flows. This course will introduce the supersonic and hypersonic environment, inviscid hypersonic flows, hypersonic laminar boundary layers, hypersonic thermo-chemical concepts, and the aero-mechanics of re-entry trajectories for spacecraft and missiles.

Contact Hours (per week): 3 Lecture Hours 0 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
AERO3312	C	N

Corequisite Course(s):	Equivalent Course(s):

Restrictions:	
Classification	Junior, Senior
Major	

**The University of Texas at El Paso
College of Engineering
Department of Mechanical Engineering
Syllabus**

Course Prefix and Number: AERO 4331

Course Title: Aerodynamics II (Supersonic and Hypersonic)

Credit Hours: 3

Prerequisite Courses:

AERO 3312: Aerodynamics I

Course Description:

The supersonic and hypersonic flow regimes are increasingly relevant in modern aerospace applications including high velocity aircraft, missiles, space launch vehicles, and space re-entry. The behavior of fluids at high speeds varies significantly from low speed flows. This course will introduce the supersonic and hypersonic environment, inviscid hypersonic flows, hypersonic laminar boundary layers, hypersonic thermo-chemical concepts, and the aero-mechanics of re-entry trajectories for spacecraft and missiles.

Learning Outcomes:

- Understand the fundamentals of hypersonic and supersonic aerodynamics, and how they differ from low speed aerodynamics
- Calculate hypersonic and supersonic flow conditions
- Analyze boundary layers of hypersonic flow and viscous interaction
- Relate chemical and temperature effects in hypersonic flows

Required Materials: John D. Anderson, Jr., *Hypersonic and High Temperature Gas Dynamics*, Mc.Graw hill Series, New York, 1996.

Course Schedule:

Week 1-3	Inviscid hypersonic flow
Weeks 4-6	Viscous hypersonic flow
Weeks 7-10	High Temperature Gas Dynamics
Weeks 11-13	Non-equilibrium Flows
Week 14	Radiative Gas Dynamics
Week 15	Applied hypersonic flow applications

COURSE ADD

All fields below are required

College : College of Engineering

Department : Mechanical Engineering

Rationale for adding the course:

Part of New Bachelor of Aerospace Engineering Degree Plan

All fields below are required

Subject Prefix and # AERO4332

Title (29 characters or fewer): Hypersonic Vehicle Design

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

Supersonic and hypersonic vehicles range from missiles, to space launch vehicles, and high altitude high speed aircraft. This course introduces the design requirements and principles for common hypersonic vehicle applications. The operating environment, operational loads, and subsystem requirements are applied to the design process.

Contact Hours (per week): 3 Lecture Hours 0 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
MECH3352	D	N

Corequisite Course(s):	Equivalent Course(s):

Restrictions:	
Classification	Junior, Senior
Major	

**The University of Texas at El Paso
College of Engineering
Department of Mechanical Engineering
Syllabus**

Course Prefix and Number: AERO 4332
Course Title: Hypersonic Vehicle Design
Credit Hours: 3

Prerequisite Courses:
MECH 3352: Engineering Analysis

Course Description:

Supersonic and hypersonic vehicles range from missiles, to space launch vehicles, and high altitude high speed aircraft. This course introduces the design requirements and principles for common hypersonic vehicle applications. The operating environment, operational loads, and subsystem requirements are applied to the design process.

Learning Outcomes:

- Critically analyze hypersonic vehicle applications and the associated environmental and operational considerations
- Apply engineering analysis to hypersonic vehicle design
- Identify requirements and data sources for hypersonic vehicle design and evaluation
- Apply computational analysis and modelling in the hypersonic vehicle process

Required Materials: All required materials will be provided

Course Schedule:

- | | |
|-------------|---|
| Week 1-5 | Missiles: design requirements; aerodynamic, structural and propulsion considerations; weight distribution and estimation; flight performance and measures of merit. |
| Weeks 6-10 | Space Launch Vehicles: design requirements; energy requirements and trajectories; structural and propulsion considerations; mass fractions; vehicle sizing and staging; aerothermodynamic environment; |
| Weeks 11-15 | Hypersonic Aircraft: mission classes and definitions; aerodynamic, structural and propulsion considerations; atmosphere and gravity models; hypersonic flight mechanics; Continuous optimal control; Guidance algorithms; |

COURSE ADD

All fields below are required

College : Engineering

Department : Aerospace Engineering

Rationale for adding the course:

New Bachelor of Science in Aerospace Engineering

All fields below are required

Subject Prefix and # AERO 4335

Title (29 characters or fewer): Structural Dynamics

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

This course is designed to introduce the students to aerospace structural dynamics. Many aerospace structures are subjected to time-varying loadings, including impact and cyclic excitations. Dynamic response to these loadings can have a character very different from static response. This dynamic behavior must be anticipated in the design of the structure if its performance is to be satisfactory.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
MECH 2340	C	N
MECH 2342	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Senior
Major	Aerospace Engineering

**The University of Texas at El Paso
College of
Department of
Syllabus**

Course Prefix and Number: AERO 4335

Course Title: Structural Dynamics

Credit Hours: 3

Prerequisite Courses: MECH 2340 and MECH 2342 both with C or better.

Course Description: This course is designed to introduce the students to aerospace structural dynamics. Many aerospace structures are subjected to time-varying loadings, including impact and cyclic excitations. Dynamic response to these loadings can have a character very different from static response. This dynamic behavior must be anticipated in the design of the structure if its performance is to be satisfactory.

Learning Outcomes:

1. Students will develop models of physical systems and represent them using standard lumped parameter components-free body diagrams.
2. Students will develop and solve the governing systems of differential equations of motion.
3. Students will calculate natural frequency and damping ratio of a single-degree-of-freedom (1-DOF) physical system.
4. Students will predict forced vibration response of a 1-DOF system.
5. Students will calculate the natural frequencies (eigenvalues) and mode shapes (eigenvectors) of a multi-degree-of-freedom physical system
6. Students will predict forced vibration response of a multi-degree-DOF systems.
7. Students will compute natural frequencies and modes of beams and plates.

Required Materials: Fundamentals of Vibrations by Leonard Meirovitch, Waveland Press, Inc., 2010, ISBN 1577666917.

Course Schedule:

1. Introduction, review of dynamics.
2. Free vibration of single-degree-of-freedom (SDOF) systems.
3. SDOF response to harmonic and periodic excitations.
4. SDOF response to nonperiodic excitations.
5. Two-degree-of-freedom (2DOF) systems.
6. Analytical dynamics, multi-degree-of-freedom (MDOF) systems.
7. Distributed-parameter (continuous) systems.

COURSE ADD

All fields below are required

College : College of Engineering

Department : Mechanical Engineering

Rationale for adding the course:

Part of New Bachelor of Aerospace Engineering Degree Plan

All fields below are required

Subject Prefix and # AERO4339

Title (29 characters or fewer): Special Topics in Hypersonics

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

Selected topics of current interest in the field of hypersonics.

Contact Hours (per week): 3 Lecture Hours 0 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Junior, Senior
Major	

**The University of Texas at El Paso
College of Engineering
Department of Mechanical Engineering
Syllabus**

Course Prefix and Number: AERO 4339

Course Title: Special Topics in Hypersonics

Credit Hours: 3

Prerequisite Courses: Dependent on the topic.

Course Description:

Selected topics of current interest in the field of hypersonics.

Learning Outcomes:

- Outcomes vary by the instructor and the type of topic presented.
- Students will be able to solve problems in the area of the special topic.

Required Materials: Dependent on the topic.

Course Schedule: Dependent on the topic.

COURSE ADD

All fields below are required

College : College of Engineering

Department : Mechanical Engineering

Rationale for adding the course:

Part of New Bachelor of Aerospace Engineering Degree Plan

All fields below are required

Subject Prefix and # AERO4351

Title (29 characters or fewer): Orbit and Attitude Dynamics

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

This course provides an overview of orbital mechanics (astrodynamics) and attitude dynamics. Two body Keplerian problems, three dimensional orbits, orbital maneuvers, restricted three body problems, spacecraft reference frames, attitude stabilization, pointing laws, disturbance torques, and spin stabilization are studied. Active spacecraft attitude control hardware is analyzed for performance and implementation. Interplanetary orbits, orbital perturbations, and formation flying are also introduced at a fundamental level.

Contact Hours (per week): 3 Lecture Hours 0 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
AERO3343	D	N
MATH2326	C	N

Corequisite Course(s):	Equivalent Course(s):

Restrictions:	
Classification	Junior, Senior
Major	

**The University of Texas at El Paso
College of Engineering
Department of Mechanical Engineering
Syllabus**

Course Prefix and Number: AERO 4351
Course Title: Orbit and Attitude Dynamics
Credit Hours: 3

Prerequisite Courses:

AERO3343: System Modelling and Control with a D or better, and
MATH2326: Differential Equations with a C or better.

Course Description:

This course provides an overview of orbital mechanics (astrodynamics) and attitude dynamics. Two body Keplerian problems, three dimensional orbits, orbital maneuvers, restricted three body problems, spacecraft reference frames, attitude stabilization, pointing laws, disturbance torques, and spin stabilization are studied. Active spacecraft attitude control hardware is analyzed for performance and implementation. Interplanetary orbits, orbital perturbations, and formation flying are also introduced at a fundamental level.

Learning Outcomes:

- Understand and predict spacecraft motion and attitude
- Apply spacecraft reference frames and pointing laws for orbit motion and attitude control
- Analyze and simulate orbit maneuvers, attitude control, and stabilization
- Evaluate performance of active control hardware

Required Materials: All required materials will be provided.

Recommended Textbook: Anton H.J. Ruiter, Christopher J. Damaren, and James R. Forbes (2013) *Spacecraft Dynamics and Control, An Introduction*, John Wiley and Sons, Inc., United Kingdom

Course Schedule:

Week 1	Rigid Body Dynamics	Kinematics review, dynamics of single particles, dynamics of systems, inertial matrix
Weeks 2-3	Keplerian Two-Body Problem	Keplerian orbital elements, coordinate systems, circular orbits, elliptical orbits, parabolic orbits,
Weeks 4-5	Orbit Maneuvers	Orbit determination, Hohmann transfers, plane change maneuvers
Week 6	Interplanetary Trajectories	Planetary Flyby, planetary capture, sphere of influence
Weeks 7	Orbit Perturbations	Special and general orbit perturbations
Week 8	Formation Flying	Relative in-plane and out-of-plane motion, relative orbits
Week 9-10	Three Body Problem	Equation of motion, Lagrangian points, Jacobi's integral
Week 11-12	Disturbance Torques	Magnetic, solar, aerodynamic, gravity-gradient
Weeks 12-13	Attitude Stabilization	Open and closed loop feedback control, spin stabilization, gravity-gradient stabilization
Weeks 14-15	Active Attitude Control	Attitude sensors, attitude actuators, control law implementation

COURSE ADD

All fields below are required

College : College of Engineering

Department : Mechanical Engineering

Rationale for adding the course:

Part of New Bachelor of Aerospace Engineering Degree Plan

All fields below are required

Subject Prefix and # AERO4353

Title (29 characters or fewer): Spacecraft Environments

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

The environment that a spacecraft must operate on is very different to the environment on the surface of the Earth. The spacecraft environment begins during construction and testing, and carries through into launch, operation in space, and end of life. This course gives an overview of all facets of the space environment including thermal, plasma, radiation, vacuum, solar, and particulates, and introduces you to environmental considerations affecting spacecraft design and operation.

Contact Hours (per week): 3 Lecture Hours 0 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
MATH 2326	C	N
PHYS 2420 or equivalent	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Junior, Senior
Major	

**The University of Texas at El Paso
College of Engineering
Department of Mechanical Engineering
Syllabus**

Course Prefix and Number: AERO 4353

Course Title: Spacecraft Environments

Credit Hours: 3

Prerequisite Courses:

MATH 2326: Differential Equations and PHYS 2420: Physics I or equivalent both with C or better.

Course Description:

The environment that a spacecraft must operate on is very different to the standard environment on the surface of the Earth that we are used to operating in. The spacecraft environment begins during construction and testing, and carries through into launch, operation in space, and end of life. This course will give you an overview of all facets of the space environment, and introduce you to environmental considerations affecting spacecraft design and operation.

Learning Outcomes:

- Understand the fundamentals of the spacecraft environment
- Apply the fundamental knowledge to specific regimes of space and systems of spacecraft
- Evaluate how the space environment effects mission and spacecraft design

Required Materials: All required materials will be provided. Recommended textbook is:

Pisacane, V., *The Space Environment and Its Effects on Space Systems*, AIAA Educational Series, ISBN 978-1-56347-926-7

Course Schedule:

Week 1	Solar	The influence of the Sun throughout the Solar System
Weeks 2-3	Vacuum	Effects of the low pressure environment including outgassing and contamination
Weeks 4-5	Neutrals	Considerations due to individual neutral gas particles such as atomic oxygen and sputtering
Weeks 6-7	Particulate	Probability and extent of damage from micro-meteoroids and orbital debris
Weeks 7-9	Radiation	Electromagnetic, neutral particle, and charged particle radiation.
Weeks 10-12	Plasma	Impact of charged particles on spacecraft operation and design, spacecraft charging and arcing.
Weeks 13-14	Thermal	Regulation of spacecraft temperature in various thermal environments, with a focus on thermal radiation.
Week 15	Launch	Environmental considerations both before and during launch. Qualification testing for spacecraft.

COURSE ADD

All fields below are required

College : College of Engineering

Department : Mechanical Engineering

Rationale for adding the course:

Part of New Bachelor of Aerospace Engineering Degree Plan

All fields below are required

Subject Prefix and # AERO4355

Title (29 characters or fewer): Space Mission Design

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

Processes involved in space-bound missions, from mission conception through to launch, operations, and end-of-life. Mission concept development and utility, space law and planetary protection, cost estimation, scheduling, operations, and end-of-life disposal requirements. How mission constraints affect spacecraft design requirements. Payload development and integration, thermal protection systems.

Contact Hours (per week): 3 Lecture Hours 0 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)

Corequisite Course(s):	Equivalent Course(s):

Restrictions:	
Classification	Senior
Major	Aerospace Engineering

**The University of Texas at El Paso
College of Engineering
Department of Mechanical Engineering
Syllabus**

Course Prefix and Number: AERO 4355
Course Title: Space Mission Design
Credit Hours: 3

Prerequisite Courses:
None

Recommended Knowledge:

The following courses are not required knowledge, but would be helpful in understanding concepts presented in this class

AERO4351: Astrodynamics and Attitude Dynamics

AERO4353: Spacecraft Environments

Course Description:

Space missions require multiple subsystems operating together in a wide range of environmental conditions, often through the collective cooperation of interdisciplinary teams under stringent operational constraints. This course provides an overview to the processes involved in a space-bound mission, from mission conception through to launch, operations, and end-of-life. The course begins with the development of the mission and its geometry, including mission concept development and utility, space law and planetary protection, cost estimation, scheduling, and end-of-life disposal requirements. These factors follow on to spacecraft design requirements and subsystem needs, including payload development and requirements, and thermal protection system design and analysis. Final course topics cover mission implementation including launch, operations, and disposal to complete mission lifecycle.

Learning Outcomes:

- Formulate mission and spacecraft constraints from environmental, political, and technological considerations
- Apply mission constraints to spacecraft design requirements
- Develop cost and schedule estimates for complex space missions
- Analyze operational and disposal requirements for space missions

Required Materials: James R. Wertz, David Everett, and Jeffrey J. Pirschell, (2011) Space Mission Engineering: The New SMAD, Macrocsm Press, USA

Course Schedule:

Week 1	Introduction to Space Missions	History of space exploration, Space communities, Principle space players,
Weeks 2-4	Space Mission Engineering	Concept definition, system drivers and critical constraints, mission analysis, requirements flow-down
Weeks 5-7	Mission Geometry	Trajectories, environment considerations, constellation designs,
Week 8	Mission Management	Mission teams, cost estimation and scheduling
Weeks 9-10	Space Policy	Space law, space policies, end-of-life requirements, planetary protection
Week 11	Spacecraft Design	Subsystem requirements from mission requirements,
Week 12	Payload Development	Payload development, design, and integration
Week 13	Thermal Protection Systems	Spacecraft structures and thermal control
Weeks 14-15	Operations	Launch vehicle requirements and capabilities, operations development, mission execution, spacecraft disposal

COURSE ADD

All fields below are required

College : College of Engineering

Department : Mechanical Engineering

Rationale for adding the course:

Part of New Bachelor of Aerospace Engineering Degree Plan

All fields below are required

Subject Prefix and # AERO4359

Title (29 characters or fewer): Special Topic in Astronautics

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

Selected topics of current interest in the field of astronautical engineering.

Contact Hours (per week): 3 Lecture Hours 0 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Junior, Senior
Major	

**The University of Texas at El Paso
College of Engineering
Department of Mechanical Engineering
Syllabus**

Course Prefix and Number: AERO 4359

Course Title: Special Topics in Astronautics

Credit Hours: 3

Prerequisite Courses: Dependent on the topic.

Course Description:

Selected topics of current interest in the field of astronautical engineering.

Learning Outcomes:

- Outcomes vary by the instructor and the type of topic presented.
- Students will be able to solve problems in the area of the special topic.

Required Materials: Dependent on the topic.

Course Schedule: Dependent on the topic.

COURSE ADD

All fields below are required

College : Engineering

Department : Aerospace Engineering

Rationale for adding the course:

New Bachelor of Science in Aerospace Engineering

All fields below are required

Subject Prefix and # AERO 4364

Title (29 characters or fewer): Aerospace Communications

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

The course will deliver fundamentals on design, implementations, and testing of communications systems in Aerospace applications. The course will provide the participants with fundamentals on digital and analog signal processing, signal losses and attenuation, and will prepare the students to design flight communication systems and ground stations using a variety of instruments.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
MECH 2342	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Senior
Major	Aerospace Engineering

**The University of Texas at El Paso
College of
Department of
Syllabus**

Course Prefix and Number: AERO 4364

Course Title: Aerospace Communications

Credit Hours: 3

Prerequisite Courses: MECH 2342 with a C or better.

Course Description: The course will deliver fundamentals on design, implementations and testing of communications systems in Aerospace applications. The course will provide the participants with fundamentals on digital and analog signal processing, signal losses and attenuation; and will prepare the students to design flight communication systems and ground stations using a variety of instruments.

Learning Outcomes: Upon completion of this course, students will be able to: understand the fundamentals of analog and digital signals; how the environment affects signal propagation; specify, design and implement communication systems for onboard and ground stations; the students will also be able to design and implement systems with common communication instruments, such as GPS and Radars.

Required Materials:

-Textbooks:

- Roddy, Dennis. Satellite communications. McGraw-Hill Prof Med/Tech, 2006.
- Tooley, Mike, and David Wyatt. Aircraft communications and navigation systems. Routledge, 2017.

-Laptop

Course Schedule:

- Fundamental on Waves and Signals.
- Wave Propagation
- Environmental losses
- Antenna Design
- Modulation
- Link Budgets
- Ground Stations
- Mobile Services and Instruments: GPS and Radar

COURSE ADD

All fields below are required

College : College of Engineering

Department : Mechanical Engineering

Rationale for adding the course:

Part of New Bachelor of Aerospace Engineering Degree Plan

All fields below are required

Subject Prefix and # AERO4365

Title (29 characters or fewer): Aerospace Systems Engineering

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

A holistic view of aerospace systems covering systems engineering; design drivers, trade studies, and design decisions; cost and weight estimation; vehicle performance; safety and reliability; lifecycle topics; vehicle attributes and subsystems; risk analysis; project management; and system realization.

Contact Hours (per week): 3 Lecture Hours 0 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
CE2326	C	N
COMM1302	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Senior
Major	

**The University of Texas at El Paso
College of Engineering
Department of Mechanical Engineering
Syllabus**

Course Prefix and Number: AERO 4365

Course Title: Aerospace Systems Engineering

Credit Hours: 3

Prerequisite Courses:

CE2326: Engineering Economics

COMM1302: Business and Professional Communication both with C or better.

Course Description:

Aerospace systems are complex and require a systematic and disciplined set of processes that are applied recursively and iteratively through design, development, operation, maintenance, and closeout. This course provides a holistic view of aerospace system engineering including design drivers, stakeholder constraints, trade studies, and design decisions; cost and weight estimation; vehicle performance; safety and reliability; vehicle lifecycle, attributes and subsystems; risk analysis; project management; and system realization.

Learning Outcomes:

- Develop system requirements from design drivers, stakeholder constraints, and components
- Apply requirements and perform trade studies in system design decisions
- Analyze complex system lifecycle through analysis and simulation
- Evaluate program management techniques for use with complex systems

Required Materials: NASA, (2016), NASA Systems Engineering Handbook, NASA/SP-2016-6105 Rev2. Available online:

https://www.nasa.gov/sites/default/files/atoms/files/nasa_systems_engineering_handbook_0.pdf

Course Schedule:

Week 1-2	Fundamentals of Systems Engineering	Technical processes, competency models, product validation
Weeks 3-5	Project Life Cycle	Project phases: formulation, concept development, design iterations, system integration, operations, closeout
Weeks 6-9	System Design Process	Stakeholder constraints, requirements definition and flow-down, trade studies, solution definitions
Weeks 10-12	System Realization	System or product implementation, integration, validation, and verification
Weeks 13-15	Project Management	Risk analysis and management, cost effectiveness and budgets, resource management, data management

COURSE ADD

All fields below are required

College : College of Engineering

Department : Mechanical Engineering

Rationale for adding the course:

Part of New Bachelor of Aerospace Engineering Degree Plan

All fields below are required

Subject Prefix and # AERO4366

Title (29 characters or fewer): Aerospace Senior Design

Dept. Administrative Code : 1920

CIP Code 14.0201.00

Departmental Approval Required ☐ Yes ☒ No

Course Level ☒ UG ☐ GR ☐ DR ☐ SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐ Yes ☒ No

Grading Mode: ☒ Standard ☐ Pass/Fail ☐ Audit

Description (600 characters maximum):

Students work on a design project specified by the instructor. They are expected to demonstrate knowledge of the engineering design process and apply the knowledge to the project.

Contact Hours (per week): 3 Lecture Hours 0 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

- | | |
|---|--|
| ☒ A Lecture | ☐ H Thesis |
| ☐ B Laboratory | ☐ I Dissertation |
| ☐ C Practicum | ☐ K Lecture/Lab Combined |
| ☐ D Seminar | ☐ O Discussion or Review (Study Skills) |
| ☒ E Independent Study | ☐ P Specialized Instruction |
| ☐ F Private Lesson | ☐ Q Student Teaching |

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	Minimum Grade Required/ Test Scores	Concurrent Enrollment Permitted? (Y/N)
MECH 3352	D	N
AERO 4322	D	N
AERO 4365	D	N
AERO 3323	D	N
AERO 3343	D	N
AERO 3312	D	N

Corequisite Course(s):	Equivalent Course(s):

Restrictions:	
Classification	Senior
Major	Aerospace Engineering

**The University of Texas at El Paso
College of Engineering
Department of Mechanical Engineering
Syllabus**

Course Prefix and Number: AERO 4366

Course Title: Aerospace Senior Design

Credit Hours: 3

Prerequisite Courses:

MECH 3352: Engineering Analysis

AERO 4322: Aerospace Propulsion

AERO 4365: Aerospace Systems Engineering

AERO 3323: Aerospace Structural Analysis

AERO 3343: System Modelling and Control

AERO 3312: Aerodynamics

Course Description:

Students work on a design project specified by the instructor. They are expected to demonstrate knowledge of the engineering design process and apply the knowledge to the project.

Learning Outcomes:

- Demonstrate the ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- Analyze and interpret data, and use engineering judgement to draw conclusions.
- Evaluate and apply the impact of engineering solutions in global, economic, environmental, ethical, and societal contexts
- Communicate effectively with a range of audiences

Required Materials: Dependent on the course project.

Course Schedule: Students work on the designated project consistently throughout the semester. Students are expected to develop a specific project schedule as part of the course.