Aerospace Engineering, BS

Program Description

The mission of the Aerospace Engineering Department is: to provide a quality undergraduate aerospace engineering education; to advance the engineering and science knowledge base through research; to assist industry in technical applications and innovations; to serve the aerospace profession through leadership in these areas.

Outcomes

***Application*:** Aerospace Engineering graduates will be able to apply aerospace engineering design principles 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.

***Communication*:** Aerospace Engineering graduates will be able to communicate effectively with a range of audiences.

***Depth of Knowledge*:** Aerospace Engineering graduates will be able to identify, formulate, and solve complex aerospace engineering problems by applying principles of aerospace engineering, science, and mathematics.

***Teamwork*:** Aerospace Engineering graduates will be able to work effectively and collaborate in team settings, will be able to consider and resolve conflicting points of view and work towards a shared professional goal.

Measure – PLO dimensions of the ADAM tool

Data Collection: AERO has introduced the ADAM (Aerospace Department Assessment Metric) tool, a construct multi-dimensional tool which includes a separate “Application”, “Communication”, “Depth of Knowledge”, “Teamwork” dimensions. We examine all the available program metrics in an academic year (3 direct and 2 indirect) and using the numerical score from each to construct a score for each dimension BS-AERO-APP, BS-AERO-COMM, BS-AERO-DOK, BS-AERO-TMW.

1. ABET course-based evaluation, direct generated by faculty, assessing the success of ABET student learning outcomes (see attached). Forms are collected by department, processed by undergraduate advisor/ABET coordinator

2. CAPSTONE (PDR, CRD) evaluation, conducted by Advisory Board, processed by undergraduate program leadership team

3 BOARD senior interviews, direct, conducted by Advisory Board, processed by undergraduate program leadership team

4. AERO Alumni survey, conducted by Department Head/ Associate DH, processed by undergraduate advisor/ABET coordinator

5. AERO Employer survey, conducted by Department Head, processed by undergraduate advisor/ABET coordinator

Methodology or data analysis strategy:

1. ABET course-based evaluation	Faculty teaching undergraduate courses collect information on the success/failure of each ABET Student Outcome related to the Learning Outcomes listed in their syllabus, using the attached form and associated rubrics/performance indicators. Course coordinators evaluate uniformity between different course sections; ABET/AEFIS coordinator collects data from individual courses and averages the data from 3XX and 4XX levels into a single program metric (direct method of assessment)
2. CAPSTONE evaluation rubric	Capstone stakeholders (faculty, board members, program managers) assess project presentations and/or reports annually, in AERO 401/402 during Design Review, and collect information using rubrics/performance indicators which follow the ABET Student Outcome taxonomy (direct method of assessment)
3. BOARD senior interview	Advisory Board members conduct senior interviews biennially, and collect information using rubrics/performance indicators which follow the ABET Student Outcome taxonomy (direct method of assessment)
4. AERO alumni survey	Department Head conducts recent Alumni survey annually and collects information in a scale of 1 to 5 for questions following the ABET SO taxonomy. The questions indirectly assess the success/failure of a specific item in the metric.
5. AERO employer survey	Department Head conducts Employee survey annually and collects information in a scale of 1 to 5 for questions following the ABET SO taxonomy. The questions indirectly assess the success/failure of a specific item in the metric.

Target

Each university learning outcome (AEFIS BS-AERO-APP, BS-AERO-COMM, BS-AERO-DOK, BS-AERO-TMW) will be successfully "Met", if a minimum of 4 out of the 5 program assessment metrics are successful, it will be "Partially Met" if a minimum of 2 out of the 5 metrics have been successful (but less than 4), and it will be considered "Not met" if less than 2 metrics have been successful. The individual metrics are considered successful in the following cases:

1. ABET course-based evaluation	Score > 3.5 (in a scale of 1 to 5). Averaging all relevant courses, 70% or more of the students perform better than 70% (percentile) in the specially designed rubrics which assess the relevant ABET Student Outcomes (SOs) based on specific instruments deployed in class (exam, project, homework, etc.)
2. CAPSTONE evaluation rubric	Score > 3.5 (in a scale of 1 to 5) in the specially designed rubrics which assess the relevant ABET Student Outcomes (SOs) based on capstone project presentation or report.
3. BOARD senior interview	Score > 3.5 (in a scale of 1 to 5) in the specially designed rubrics which assess the relevant ABET Student Outcomes (SOs) based on interview with the board.
4. AERO alumni survey	Score > 3.5 (in a scale of 1 to 5) in items relevant to the specific outcome. Indirect survey questionnaire follows ABET taxonomy
5. AERO employer survey	Score > 3.5 (in a scale of 1 to 5) in items relevant to the specific outcome. Indirect survey questionnaire follows ABET taxonomy

Finding: Met

AEFIS Outcome	1 Faculty course evaluation	2 Capstone evaluation	3 BOARD interview	4 AERO Alumni survey	5 AERO Employer survey
APP	4.54	4.37	4.50	3.74	4.30
COM	4.92	4.48	--	3.66	4.36
DOK	4.47	--	4.30	3.93	4.25
TMWK	4.76	4.39	--	4.20	4.53

Since all scores are larger than 3.5, we may conclude that targets for all AEFIS Outcomes were met satisfactorily, in 5/5, or 4/4 available instruments.

Data collection during AY 2021-22 was more complete than any prior year, due to the ongoing ABET review. Scores increased across the board for all existing direct assessment instruments. The specific AEFIS outcome/ADAM dimension BS-AERO-APP has improved w.r.t. the previous year, mostly because of the drastic increase in ABET SO2 score in BOARD/IAARP assessment. The latter had a very low score (3.2) in Spring 2021, and for that reason the Board interview was repeated in Fall 2021, using quantitative rubrics. This was a successful case of data-driven action from the past AEFIS assessment (AY 2020-21). One of the new indirect instruments used in AY2021-22, Alumni Survey, contributed a low, non-passing score (3.13) in ABET SO2 Design, which is incorporated into the AEFIS BS-AERO-APP Outcome. This is probably a 'hysteresis' effect, since recent graduates who contribute to the instrument were affected by the recent re-organization of capstone design courses

(AERO 401/402). We'll pay attention to that score, but the belief is that the indirect instrument will also increase in score in the next year or two.

Use of Results

Instructors in courses with a 'heavy' mathematical content had commented often that aerospace engineering students often seemed to lack the basic required knowledge of Linear Algebra. Some unsuccessful assessments, or even successful assessments with low scores shown in Table 4-4 have been attributed to lack of basic math, e.g., AERO 222 ("Introduction to Aerospace Computation") in Spring 2020A, AERO 211 ("Aerospace Engineering Mechanics") in Fall 2021C, AERO 301 ("Theoretical Aerodynamics") in Fall 2021C, AERO 310 ("Aerospace Dynamics") in Fall 2020C, etc. A review by the APC committee showed that students in the program receive no formal instruction in Linear Algebra before taking AERO 222. Neither the prerequisites MATH 151/152/251 ("Engineering Mathematics I/II/III"), MATH 308 ("Differential Equations") nor ENGR 102 ("Introduction to Engineering") include linear algebra. Therefore, AERO faculty voted in a spring 2022 (April 22, 2022) faculty meeting to create a new required sophomore AERO course titled "Computational Linear Algebra", which will be taught for the first time in 2023. In April 2022, a committee of aerospace faculty began to develop a detailed syllabus for this new course. First assessment results should be expected in Fall 2023C.

Status Update on a Previous Action

After feedback received from all stakeholders, the program capstone design sequence (AERO 401/402) was restored into its original schedule:

This topic was also raised in many interactions with students, such as informal senior-exit interviews. In the Fall 2021C, department leadership restored the original scheduling of the capstone design courses, so that both AERO 401 and 402 are now taught in both fall and spring semesters. Indications point to a substantial increase in assessment scores, for example SO2 scores in all direct instruments in AY 2021-22.

In a related issue: Driven by feedback received from students during exit interviews, Board members, and past assessment results, department leadership initiated a discussion among all stakeholders. This led to the creation of a new systems-oriented capstone AERO 401 course, which is taught by faculty members in the newly-formed Systems Design and Human Integration (SDHI) group, and the introduction of multiple sections of the AERO 402 course, which would be taught by PoP as well as TTF, and would cover all aspects of design from traditional Design/Build/Test/Fly to novel topics of complex aerospace systems related to faculty interests, such as space-suit design, hypersonic vehicle design, etc. This action was also connected to focused hiring of faculty with expertise in systems design, or who would be capable of leading this effort. The capstone design sequence has reached its "steady state" in AY2021-22, and assessment scores seem to point to success in the long-term approach (changes begun in AY2017-18).