

# New Curriculum or Curricular Change EFD Template



College of Engineering

Engineering Faculty Document No.:

[EFD #]

[Select date.]

**TO:** The Engineering Faculty  
**FROM:** The Faculty of the School of Aeronautics and Astronautics  
**RE:** New Engineering Certificate

The Faculty of the School of Aeronautics and Astronautics has approved the following new Certificate from the College of Engineering. This action is now submitted to the Engineering Faculty with a recommendation for approval.

**TITLE:** Space Engineering

**DESCRIPTION:**

The faculty of the School of Aeronautics and Astronautics leads a multi-School effort to provide Purdue undergraduate students with an opportunity to acquire documented educational experiences in space engineering. This 16-credit certificate guides students through their choice of topics within the vast collections of topics that make up space exploration, space commerce, space communications, space life support and habitation, space power, space policy, and more, based on existing courses on the WL campus plus one new multi-disciplinary seminar course by AAE.

**RATIONALE:**

Without this Certificate, only those students who can be admitted into AAE can document their aerospace interest and aerospace-related educational experiences from Purdue. AAE has become overcrowded, growing constantly for the last two decades, and student interest in aerospace careers is not waning. So an option for additional students to gain aerospace educational experiences is one part of a solution to the long-running problem of student interests exceeding the capacity of AAE.

Please see attached document for complete information about the certificate definition, including information about target audiences and a detailed plan of study.

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Head/Director of the School of Aeronautics and Astronautics

Link to Curriculog entry:

[Paste link to Curriculog entry.]

## New Certificate Information Checklist

### DOCUMENTS AND TEMPLATES

1. Memorandum Regarding New Program Needs for required courses outside of the proposing College. *All required undergraduate courses offered outside the proposing college require prior approval from the college as part of the PWL proposal process. Use the template: <https://purdue.datacookbook.com/institution/terms/291598>*
  - a. Graduate: Optional
  - b. PWL Undergraduate: Upload complete.
  - c. PFW/PNW Undergraduate: Optional

Not applicable, this undergraduate Certificate proposal contains no required courses from outside of the proposing college.

### GENERAL INFORMATION

1. College/School and Department – The School of Aeronautics and Astronautics in the College of Engineering is the host organization. To date, faculty representatives from the Schools of Civil Engineering, Electrical and Computer Engineering, Industrial Engineering, and Mechanical Engineering have participated in defining the Certificate.
2. Certificate Type –  
Undergraduate Certificate: Award of less than 1 academic
3. Certificate Name: Certificate in Space Engineering
4. Certificate Description  
Students will acquire fundamentals and principles in engineering topics that are important in the broad and multi-disciplinary fields of space exploration, space commerce, space research, or similar. A choice of topical focus is made by the student. The Certificate documents the student's background in these aerospace topics.
5. Proposed CIP Code  
14.0202 Astronautical Engineering.
6. Modality  
Residential
7. If more than one modality selected, will the curricula be identical across modalities?  
Not Applicable - only one modality selected
8. Will this be offered at Indianapolis?  
Not at present. But as Indianapolis programs evolve and dependable information becomes available, the topic should be revisited.

### CURRICULUM AND RESOURCES DESCRIPTION

9. Prospective Curriculum  
See appended pages. Only a new 1-credit seminar course hosted by AAE will need to be created.
10. Is this a Revenue Share program? No

11. Is at least 50% of the requested certificate program made up of existing courses, or is the program a subset of an existing degree program?

Yes. At least 50% is existing courses

12. Total Credits ## of the Certificate program: 16 credits

13. Learning Outcomes for Certificate

Students will have gained some experience in and good appreciation for the multi-disciplinary nature of the field of aerospace. Whether a student seeks a career related to space exploration, space science, rocket propulsion, space commerce, space communications, space life support systems, and additional topics in this vast field, the student will pursue a structured path through aerospace-related courses and an experiential educational opportunity to become better suited for a career in the part of aerospace that interests them the most.

14. How does this certificate align and support the host department and college? Please describe the distinction from other available certificates.

Presently there are no other space-related certificates at Purdue. This certificate aids the host School and others across campus by acknowledging that the breadth of topics in aerospace is mor broad than even AAE can teach, thereby expanding the opportunities for students to receive documented aerospace educational experiences at Purdue without enrolling in the already crowded AAE program. The Certificate permits students outside of AAE to pursue an appropriate aerospace-focused path to aid their future careers.

15. Summarize the skills, licenses/certifications, and competencies the target audience will learn as a result of completing the proposed certificate.

Increased knowledge of and appreciation for the diverse multi-disciplinary nature of the aerospace industry and career in the industry. Exposure to system-level thinking and engineering.

16. Projected Headcount

In recent years, there have been approximately 50 fully qualified students from First Year Engineering unable to enter School of Aeronautics and Astronautics because of lack of space. Additionally, AAE is overloaded by at least one hundred students per year, and some of these students could find the combination of a degree from another School in COE plus this Certificate an attractive alternative to the AAE degree. Additionally, there are students who chose away from AAE but have some interest in an aerospace career, and some of these students would find the Certificate attractive. So between 50 and 150 students per year might pursue this Certificate.

17. Does the proposal call for a new tuition rate or fee that is not already in use?

No

18. Are students required to enroll in a degree seeking program while pursuing the certificate? *This information is used by Division of Financial Aid to determine aid eligibility.*

Yes

19. Please select the description of certificate length and category.

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Less than 1 year and leads to occupation with a Standard Occupation Code

20. Enter the selected Standard Occupation Code or N/A

17-2011.00

17-3021.00

21. Admission Requirements

No additional admission requirements.

**Undergraduate Certificate in Space Engineering**  
Originating/Sponsoring Unit: School of Aeronautics and Astronautics

As approved March 27, 2024 by AAE faculty

The Certificate in Space Engineering will be open to students in all undergraduate majors who are interested in a career in the aerospace industry.

The word “aerospace” as used here denotes specifically travel or activity outside of Earth’s atmosphere or the ascent through the atmosphere to space. The global aerospace industry - private companies, government agencies like NASA, etc. - has been growing for the last two decades and employs people in a vast collection of topics that includes every engineering topic at Purdue and a large number of topics from outside of engineering. This demand for a highly-varied workforce drives creation of the Space Engineering Certificate to create and document aerospace education beyond the annual class of graduates from AAE. Indeed, neither AAE nor any other aerospace department in the world delivers an education in all of the fields needed by aerospace industry, so expanding outside of AAE is very logical. Traditionally, numerous non-AAE Purdue graduate have gone into aerospace careers, and this Space Engineering Certificate is designed to expand participation of Purdue graduates in this productive tradition. Aerospace is becoming more international – India and Japan have both reached the moon in recent months – and Purdue’s student body is similarly global in scope.

**Requirements for the Certificate**

Undergraduate students seeking to earn the Space Engineering Certificate shall take a minimum of 16 credits in this distribution:

1. A one-credit Space Engineering seminar course
2. A minimum of 9 credits in a Primary Space Industry topic from the list below
3. A minimum of 3 credits in a Secondary Space Industry topic from the list below
4. Of the 16 credits, 9 or more must be from outside of the School of the student’s primary BS degree.
5. If a course below is listed in more than one topic, that course can be counted in either the Primary or Secondary topic as needed by a student but not in both topics.
6. Participation in a documented, significant practical aerospace experience. The experience need not provide course credit. Examples of these practical experiences include:
  - Campus-based research experience in aerospace topic or topics;
  - Successful completion of design-build-test project course in an aerospace topic. Credits earned for this aerospace design-build-test course are counted towards the required 16 credits.
  - Relevant project-based experience through a Purdue student organization (e.g., Purdue Space Program) or sponsored competition (e.g., NASA Lunabotics);
  - Off-campus (including paid) internship or co-op rotation in an aerospace topic;

**Humans Living In and Exploring Space:** Chose one column as Primary or Secondary topic and your other Primary or Secondary topics must be one of the other five topics below which are not part of Humans Living In and Exploring Space.

<b>Habitat Design including ISRU</b>	<b>Habitat Life Support/Thermal</b>	<b>Habitat Robotic Construction</b>
AAE 552 Nondestructive Evaluation of Structures and Materials AAE 553 Elasticity in Aerospace Engineering AAE 55400 Fatigue of Structures and Materials AAE 558 Finite Element Methods in Aerospace Structures AAE 571 Complex System Safety CE 473 Reinforced Concrete Design CE 474 Structural Analysis II CE 483 Geotechnical Engineering II CE 570 Advanced Strength of Materials CE 571 Earthquake Engineering CE 573 Structural Dynamics CE 576 Advanced Reinforced Concrete Design CE 595 Finite Elements in Elasticity ME 539 – Introduction to Scientific Machine Learning ME 562 Advanced Dynamics ME 563 Mechanical Vibrations ME 571 Reliability Based Design	AAE 590 Aerospace Human Factors AAE 571 Complex System Safety ABE 495 Space Biology and Medicine CE 413 Building Envelope Design and Thermal Loads CE 514 Building Controls ME 415 Energy Systems Engineering ME 418 Engineering of Environmental Systems & Equipment ME 501 Statistical Thermodynamics ME 505 – Intermediate Heat Transfer ME 506 Two-Phase Flow ME 511 Heat Transfer in Electronic Systems ME 539 Introduction to Scientific Machine Learning ME 575 Theory and Design of Control Systems ME 578 Digital Control ME 588 Mechatronics – Integrated Design of Electro-Mechanical Systems	AAE 552 Nondestructive Evaluation of Structures and Materials CE 483 Geotech II EAPS 557 Introduction to Seismology ECE 320 Electromechanical Motion Devices IE 590 Electromechanical Robotic Systems ME 365 Measurement and Control Systems I or AAE 364 ME 375 Measurement and Control Systems II ME 588 Mechatronics – Integrated Design of Electro-Mechanical Systems ME 572 Analysis and Design of Robotic Manipulators ME 575 Theory and Design of Control Systems ME 578 Digital Control

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### **Communications and Cybersecurity in Space**

AAE 440 Spacecraft Attitude Dynamics  
AAE 571 Complex System Safety  
AAE 575 Introduction to Satellite Navigation and Positioning  
CNIT 320 Policy, Regulation, And Globalization in Information Technology  
CNIT 415 Advanced Coding Security  
CNIT 417 Critical Infrastructure Security  
CNIT 455 Network Security  
ECE 404 Introduction to Computer Security  
ECE 438 Signal Processing  
ECE 440 Transmission of Information  
ECE 544 Digital Communications

### **Science Missions and Space as a Laboratory**

AAE 418 Zero-gravity Flight Experiment  
AAE 518 Zero-gravity Fluid Dynamics  
AAE 523 Introduction to Remote Sensing  
AAE 571 Complex System Safety  
AAE 590 Attitude Determination and Control  
CE 502 Geometrics  
CE 510 Map Projections and Geometric Geodesy  
CE 511 GPS Surveying  
EAPS 353 Earth and Planetary Surface Processes  
EAPS 354 Earth and Planetary Geophysics  
EAPS 367 Survey of Planetary Atmospheres  
EAPS 381 Geology for Engineers I or 385  
EAPS 385 Principles of Engineering Geology  
EAPS 445 Spacecraft Design  
EAPS 556 Planetary Surface Processes  
EAPS 557 Introduction to Seismology  
EAPS 567 Planetary Atmospheres  
EAPS 588 Impact Cratering  
ECE 577 Engineering Aspects of Remote Sensing  
ME 506 Two-Phase Flow  
ME 571 Reliability Based Design

### **Space Commerce and Policy**

AAE 571 Complex System Safety  
CNIT 320 Policy, Regulation, And Globalization in Information Technology  
CNIT 371 Cyberlaw and Ethics  
ECON 251 Microeconomics  
ECON 252 Macroeconomics  
IE 490 Supply Chain Engineering  
IE 546 Economic Decisions in Engineering  
IE 590 Supply Chain Engineering and Analytics (under development)

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### **Space Transportation**

AAE 338 Thermal Sciences  
AAE 339 Aerospace Propulsion  
AAE 351 Aerospace System Design  
AAE 440 Spacecraft Attitude Dynamics  
AAE 450 Spacecraft Design  
AAE 490 Orbital Analysis  
AAE 518 Zero-gravity Fluid Dynamics  
AAE 532 Orbital Mechanics  
AAE 533 Space Traffic Management  
AAE 534 Spacecraft Electric Propulsion  
AAE 535 Propulsion Design, Build, Test  
AAE 539 Advanced Rocket Propulsion  
AAE 564 - Systems Analysis and Synthesis  
AAE 565 Guidance and Control of Aerospace Vehicles  
AAE 571 Complex System Safety  
AAE 575 Introduction to Satellite Navigation and Positioning  
AAE 590 Attitude Determination and Control  
ME 315 Heat and Mass Transfer  
ME 463 Engineering Design (when a Space Engineering-related project is performed)  
ME 505 Intermediate Heat Transfer  
ME 506 Two-Phase Flow  
ME 562 Advanced Dynamics  
ME 571 Reliability Based Design  
NUCL 351 Nuclear Thermal-Hydraulics II  
NUCL 355 Nuclear Thermohydraulics Laboratory  
NUCL 551 Mass, Momentum, And Energy Transfer In Energy Systems

### **In-space Manufacturing, Assembly, debris management**

AAE 418 Zero-gravity Flight Experiment  
AAE 532 Orbital Mechanics  
AAE 533 Space Traffic Management  
AAE 440 Spacecraft Attitude Dynamics  
AAE 590 Attitude Determination and Control  
IE 470 Manufacturing Processes I / II  
IE 484 Integrated Production Systems I / II  
IE 472 Imagine, Model, Make  
IE 490 Supply Chain Engineering  
IE 566 Production Management Control  
IE 574 Industrial Robotics and Flexible Assembly  
IE 583 Design and Evaluation of Material Handling Systems  
IE 590 Nanomanufacturing  
IE 590 Electromechanical Robotic Systems  
ME 490 [*In-Space Manufacturing and Assembly*] Prof. Malshe is creating for 2024

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