



UNIVERSITY OF NEW HAMPSHIRE STUDENTS FOR THE EXPLORATION AND DEVELOPMENT OF SPACE

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OVERVIEW

University of New Hampshire Students for the Exploration and Development of Space is a multidisciplinary organization consisting of students from every year and degree. Over the past three years UNH SEDS will have hosted 24 Senior Capstones ranging from Mechanical, Electrical, Computer, and now, Engineering Physics. Senior members have the opportunity to manage the student body and develop technical skills all while working towards building UNH's first, student build Hybrid Rocket. The breakdown of the engineering team (consists of ME, EE, CS and PE) is detailed below in the graphics.

GOALS

Team Project Statement: The goal of this year's project is to design, manufacture and fly a hybrid rocket to 10,000 feet as part of the Spaceport America Cup in June 2020. The team members will be primarily responsible for the development of the propulsion module (Runaway), the structural frame, composite airframe, and the mechanical side of recovery/payload. The main engineering objectives include; achieve an apogee as close to 10,000 feet as possible, successful deployment and landing of a research payload, full rocket recovery by dual deployment parachute strategies and live GPS tracking.

Personal Project Statement: The goal of my personal senior project is to lead, design, and, manufacture the Frame structure for the hybrid rocket. In terms of the organization, this includes leading two other ME senior projects, and numerous underclassmen. In terms of the technical portion of my senior project, I will be designing, analyzing, and manufacturing the rocket body. Through FEA, SOLIDWORKS, and general structural analysis I hope to produce a structure capable of handling the forces produced by RUNAWAY (our hybrid engine) and overall aerodynamic flight.

As the Spaceport America Cup competition is post-graduation, my senior project will not include our performance at competition, but simply the design, analysis, and assembly of the rocket. These tasks shall be completed prior to graduation aligned with the completion of PHYS 797 course.

SPECIFICATIONS

Design Criteria: Design/research constraints based on the project/research statement can help narrow down the possible design/research options. See assignment document for additional detail.

- Low-weight, factors in with propulsion data.
- Propulsion required to reach 10,000 feet for a given weight.
 - Points assigned based on proximity to this altitude. Points lost for going over 10K.
- Naturally stable, non-toxic propellants.
- Stable flight of the rocket, between 1 - 2 body calibers.



- Adhere to all Spaceport America Cup Design Requirements.
 - Launch rail exit velocity (>50 m/s).
 - Payload mass and volume requirements.
 - Ground Test Demonstration of Recovery System.
 - ...etc. see (<http://www.soundingrocket.org/sa-cup-documents--forms.html>) for full details.
- Ensure the safety of all operators and bystanders during testing, launch and manufacturing.
 - Safety critical wiring.
 - Redundant Electronics including separate power supply if primary system fails.
 - Pressure testing of combustion chamber (achieve FOS of 2).
 - Stability of rocket body in flight is stipulated.
 - Ability to empty oxidizer tank without passing through combustion chamber.
 - Two-factor arming of the vehicle ignition and all energetic (blackpowder, etc) devices.
- Adhere to all legal aspects of rocket launch, testing and design.
 - Specific approval required to utilize thrust vectoring modifications.
- Adhere to the strict timeline set out by the Spaceport America Cup.
- Ability to consistently retrieve the rocket and payload post-launch.
- Rocket is fully operational before May 2020 and able to launch at Spaceport America in New Mexico in June 2020.
 - Must be able to operate in the conditions of the New Mexico desert in June.
- Keep costs reasonable, fundraising required.
- Design and manufacture for the continuation of the project onto next year's team

MILESTONES

Planned Tests:

Date	Type	Description	Status	Comments
3/6/19	Ground	Hotfire Test	Minor Issues	Successful Ignition, Flow Regulation Mechanical Issue
8/20/19	Ground	Hotfire Test	Major Issues	Nozzle Axial Stress Failure
10/10/19	Ground	Hotfire Test	Minor Issues	Electrical Failure, Premature Ignition
10/24/19	Ground	Hotfire Test	Minor Issues	Unsuccessful Ignition.
10/31/19	Ground	Hotfire Test	TBD	Runaway V1 Final Hotfire
10/31/19	Other	Combustion Chamber Hydrostat Testing	TBD	Pressure Testing Combustion Chamber
11/28/19	Ground	Hotfire Test	TBD	Runaway V2 Hotfire
2/8/19	Ground	Hotfire Test	TBD	Runaway V3 Hotfire
4/8/19	Ground	Hotfire Test	TBD	Runaway Final Hot-Fire