

# ASEN 5158 SPACE HABITAT DESIGN

Fall 2021  
Tuesday/Thursday 1005-1120  
Room Aero N240

*Lecture recordings available on Canvas after class*

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## Course Objectives

Utilize systems engineering methods to design and analyze a spacecraft intended for human occupancy with functional knowledge of the technologies used to sustain life. Emphasis placed on deriving requirements from stated mission goals and objectives, developing integrated functional schematics into a conceptual design, and analyzing design options by mass/volume estimation, including launch vehicle selection.

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## Office Hours

To be set...

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Textbook – either eBook or Print, your choice, this is a nice reference book with lots of useful design info

*Human Spaceflight Mission Analysis and Design*, Larson, McQuade and Pranke (2<sup>nd</sup> ed.), 2014/15

<https://spacetechnologyseries.com/books/Human-Spaceflight.html>

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## Topics (contents and sequence subject to minor revision during the semester)

Introduction to Human Spaceflight

Human Space Mission Objectives and Design Process

Space Environments – Orbit, Planets and NEO's

Human Physiology ~*alive and healthy*

Ergonomics, Human Factors and Psychology ~*happy and productive*

Systems Engineering Terminology, Definitions, Acronyms and Design Phases

## **Exam 1** ~*Requirement Drivers*

Design Reference Mission (DRM) / Concept of Operations (ConOps)

Functional Decomposition Process

Requirements, Constraints and Ground Rules & Assumptions (GR&A)

Operational Concept (OpsCon)

Fundamentals of Orbits and Entry / Descent/ Landing / Ascent (EDLA) ~*getting there and back*

Defining and Sizing Spacecraft Elements (orbital and surface habitats) ~*support needs of the crew*

Human-Rating Process, 'Human in the Loop' Design Drivers ~*Accommodate, Utilize and Protect*

Determining Habitable Volume

Environmental Control & Life Support System (ECLSS) Functions & Enabling Technologies  
Atmosphere Management  
Water Management  
Food Supply  
Waste Processing

Crew and Payload Accommodations (CA / PA)  
Spacesuits and Extravehicular Activity (EVA)

## **Exam 2** ~*Design Solutions*

Functions, Integration and Interfaces summarized for the following remaining spacecraft subsystems  
Command, Control and Communication (C3)  
Attitude Determination and Control Sys (ADCS) / Guidance Navigation and Control (GNC)  
Power  
Thermal Control  
Structures  
Spacecraft Propulsion  
Launch / Transfer Systems

*in situ* Resource Utilization (ISRU)

Risk Management – Ch 8  
Hazard Identification and Analysis  
Failure Mode Effects Analysis (FMEA)  
Probabilistic Risk Assessment (PRA)  
Risk Mitigation Strategies (redundancy, reliability, robustness, FOS, margins, DFMR, etc.)  
Verification & Validation (V&V) / Manufacturability / Test / Operations

**Final** ~ *Group Project Reports due and Final Briefings given on Saturday Dec 11 1:30-4 pm*

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### Grading

**20% for Homework, 40% from 2 Exams** (20% each), **40% from Group Project** (with individual weighting as warranted). **Unexcused late submittals** will be penalized a minimum of 10% with up to 2% per day lost for each additional day. This includes individual contributions to group submittals.

**Missed quizzes/exams/presentations** will not be made up unless acceptable arrangements are made at least one week in advance of due date - documented emergencies (medical, jury duty, etc.) excepted, other events considered on a case-by-case basis (early vacation departure prior to fall and winter break not allowed).

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### Emails

Please note that I get a lot of email, so to ensure a timely response, be sure to indicate 'ASEN 5158' in the subject line or reply to my original message when requested so the subject remains.

## Policies on Disabilities, Absences, Behavior and other Guidelines

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### Classroom Behavior

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy.

For more information, see the policies on [classroom behavior](#) and the [Student Conduct & Conflict Resolution policies](#).

### Requirements for COVID-19

As a matter of public health and safety due to the pandemic, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements and all public health orders in place to reduce the risk of spreading infectious disease. Students who fail to adhere to these requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to [Student Conduct and Conflict Resolution](#).

For more information, see the policy on [classroom behavior](#) and the [Student Code of Conduct](#). If you require accommodation because a disability prevents you from fulfilling these safety measures, please follow the steps in the “Accommodation for Disabilities” statement on this syllabus.

As of Aug. 13, 2021, CU Boulder has returned to requiring masks in classrooms and laboratories regardless of vaccination status. This requirement is a temporary precaution during the delta surge to supplement CU Boulder’s COVID-19 vaccine requirement. Exemptions include individuals who cannot medically tolerate a face covering, as well as those who are hearing-impaired or otherwise disabled or who are communicating with someone who is hearing-impaired or otherwise disabled and where the ability to see the mouth is essential to communication. If you qualify for a mask-related accommodation, please follow the steps in the “Accommodation for Disabilities” statement on this syllabus.

In addition, vaccinated instructional faculty who are engaged in an indoor instructional activity and are separated by at least 6 feet from the nearest person are exempt from wearing masks if they so choose.

Students who have tested positive for COVID-19, have symptoms of COVID-19, or have had close contact with someone who has tested positive for or had symptoms of COVID-19 must stay home. In this class, if you are sick or quarantined, please coordinate with instructor to determine the best plan of action.

### Accommodation for Disabilities

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the [Disability Services website](#). Contact Disability Services at 303-492-8671 or [dsinfo@colorado.edu](mailto:dsinfo@colorado.edu) for further assistance. If you have a temporary medical condition, see [Temporary Medical Conditions](#) on the Disability Services website.

### Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

### Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code academic integrity policy. Violations of the Honor Code may include, but are not limited to: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code ([honor@colorado.edu](mailto:honor@colorado.edu)); 303-492-5550).

Students found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found on the [Honor Code website](#).

### Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

The University of Colorado Boulder (CU Boulder) is committed to fostering an inclusive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, or protected-class discrimination or harassment by or against members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or email [cureport@colorado.edu](mailto:cureport@colorado.edu). Information about OIEC, university policies, [reporting options](#), and the campus resources can be found on the [OIEC website](#).

Please know that faculty and graduate instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, dating and domestic violence, stalking, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about their rights, support resources, and reporting options.

### Religious Holidays

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, **please coordinate with instructor at least 2 weeks ahead of time** to determine the best plan of action.

See the [campus policy regarding religious observances](#) for full details.