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.

Office Hours
To be set...

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

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

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

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).

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.
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 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); 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. 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.