Syllabus

ASEN 6116

Spacecraft Life Support Systems

Credits (3)

TuTh, 11:30am-12:45pm, AERO N240

Instructor: Prof. James Nabity james.nabity@colorado.edu

Office hr: Th, 3-4pm or by appointment

Office hr: TBD

Course Description:

In this course we study Environmental Control and Life Support System (ECLSS) technologies that keep people alive and healthy in space. What are the physiological needs of astronauts and what are the available technologies to meet them? How do the mission requirements affect the ECLSS design? Students will study atmosphere revitalization processes, thermal control systems, water reclamation and treatment, waste handling and the reuse of materials, along with food and nutrition. Teams will develop analytical models from first principles followed by computational studies using V-Hab or other appropriate software packages to model and simulate a CO2 removal system. Upon completing this course students should be able to:

- define the drivers and functional requirements important to ECLSS design,
- describe the technical challenges for robust ECLSS development,
- comprehend and describe the physicochemical processes used in ECLS systems and comparatively assess competing technologies,
- describe and apply tools to analyze ECLS components and systems, and
- apply this knowledge to discover and develop better ways to support the human exploration of space.

The semester concurrently entails a series of lectures, assignments and analytical/computational investigations. Student work is evaluated by performance on homework assignments and quizzes, an individual research paper, an individual comprehensive exam, a team paper describing analytical and computational results (journal article quality) and a team presentation to the class.

Prerequisite / Co-requisite:

ASEN 5158 Space Habitat Design, ASEN 5016 Space Life Sciences, or approval of the instructor

Required Materials:

Ewert, Michael et al. (2022), Baseline Values and Assumptions Document, NASA/TP-2015–218570/REV2. Available online at

Life Support Baseline Values and Assumptions Document - NASA Technical Reports Server (NTRS)Links to an external site.

Young, Larry and Sutton, Jeffrey (ed.), Handbook of Bioastronautics, https://doi.org/10.1007/978-3-319-10152-1

Available online from Elsevier through CU login

Handbook of Bioastronautics | SpringerLinkLinks to an external site.
P.O. Wieland (1998), "Living together in space the design and operation of the life support systems on the International Space Station," NASA/TM—98–206956/VOL1. Available online at https://ntrs.nasa.gov/api/citations/19980037427/downloads/19980037427.pdfLinks to an external site.

Exposure Guidelines (SMACs & SWEGs)

https://www.nasa.gov/feature/exposure-guidelines-smacs-swegsLinks to an external site.

SMACs - Spacecraft Maximum Allowable Concentrations for Selected Airborne Contaminants

SWEGs - Spacecraft Water Exposure Guidelines for Selected Waterborne Contaminants

Recommended (but not required) Supplemental Materials:

Erik Seedhouse, Life Support Systems for Humans in Space, Springer Praxis Books, ISBN 978-3-030-52859-1, 2020. https://www.springer.com/gp/book/9783030528584

Courtney G Brooks, James M. Grimwood, Loyd S. Swenson, Chariots for Apollo: A History of Manned Lunar Spacecraft, NASA Special Publication 4205, https://history.nasa.gov/SP-4205.pdf

Peter Eckart, Spaceflight Life Support and Biospherics, Space Technology Library, Microcosm Press and Kluwer Academic Publishers, 1996. $133.71 (sale price) for hardcover from Springer, Amazon Market Place and other sources. Occasionally can find a used softcover copy for much less.

Wiley J. Larson and Linda K. Pranke, Human Spaceflight Mission Analysis and Design, Space Technology Series, The McGraw-Hill Companies, 2007.

Carol Norberg, Human Spaceflight and Exploration, Springer Praxis Books, ISBN 978-3642237249, 2013. $149.99, https://www.springer.com/us/book/9783642237249

Course Assignments (additional information to be provided when assigned):

- Research Paper: A Life Support Technology Review – Individual Work, 25% of final grade
- Mid-term Take Home Exam – Individual Work, 30% of final grade
- Investigative Study: A journal quality research paper and presentation to report results – Team Work, 35% of final grade
- Quizzes – Individual Work, 5% of final grade
- Homework – Individual Work, 5% of final grade

Academic Integrity and Grade Schedule:

Letter Grade	Percent Grade	4.0 Scale
A	93-100	4.0
A-	90-92	3.7
B+	87-89	3.3
B	83-86	3.0
B-	80-82	2.7
C+	77-79	2.3

Letter Grade	Percent Grade	4.0 Scale
C	73-76	2.0
C-	70-72	1.7
D	65-69	1.0
F	Below 65	0.0

Successful students will put in approximately 12-15 hrs per week to complete the assignments and earn a B or better grade in this course. *Late work (i.e., that work turned in after the deadline given by the instructor) will be docked 10 pts or one full letter grade for each week late.* For AES graduate students, a course mark below B- is unsatisfactory and will not be counted toward fulfilling the minimum requirements for the degree.

Student attendance is an important part of your training as an engineer and scientist. A cordial atmosphere is expected at all times within the classroom and laboratory. Respect and be courteous to other students. Maintain a quiet work atmosphere; excessive noise distracts others. Assist your fellow graduate students. This is an important part of your training for the future. You will often be working in a group environment, so be a responsible team member. When you are required to share equipment with others, transfer data/codes/etc., do so in a professional manner.

ACADEMIC INTEGRITY (including genAI)

In all academic work, the ideas and contributions of others must be appropriately acknowledged and work that is presented as original must be, in fact, original. We expect students to follow the highest standards of ethics in their research and publications. Plagiarism, data manipulations, etc. are examples of unethical behavior and are not tolerated. Using an AI-content generator (such as ChatGPT) to complete coursework without proper attribution or authorization is a form of academic dishonesty. If you are unsure about whether something may be plagiarism or academic dishonesty, please contact your instructor to discuss the issue.

In my class, you may use gen AI tools on homework in this course, HOWEVER THEIR USE IS LIMITED to the following particular tasks:

- Checks to improve grammar, but NOT to draft or enact major revision of sections of the assignment.

- Generating key words and phrases or ideas or outlines for a report or manuscript is acceptable, BUT the final work must be student-generated, summarizing or synthesizing research, with proper critical evaluation and original analysis or as outlined for the assignment.

If you use gen AI tools on assignments in this class, document your usage with the Chicago Manual of Style (link below) or appropriate citation guidelines for this course.

https://www.chicagomanualofstyle.org/qanda/data/faq/topics/Documentation/faq0422.html

Please note, in case of issues with Academic Integrity, the burden does not fall on the instructor to prove that AI was used, but rather on the student to prove that learning has occurred. If I suspect that you have used AI outside of defined bounds to complete an assignment instead of engaging with the concepts, your assignment will initially receive a 0, and in order to receive credit for the assignment, you will be required to meet with me to discuss your submission and how you arrived at your response.

SYLLABUS STATEMENTS

See https://www.colorado.edu/academicaffairs/about/policies-customs-guidelines/required-syllabus-statements