Syllabus

ASEN 6116 Spacecraft Life Support Systems

Credits (3)

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

Instructor: Prof. James Nabity, AERO N305, james.nabity@colorado.edu

Office hrs: by appointment

TF: Brett Bennett

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 to explore system level dynamics of environmental control and life support. 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 http://spaceflightsystems.grc.nasa.gov/repository/NRA/tm206956v1%20living%20together%20%20in%20space.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
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. We expect that students follow the highest standards of ethics in their research and publications. Plagiarism, data manipulations, etc. are examples of unethical behavior and are not tolerated. The instructor or your advisor can help you and/or refer you to the proper channels if the ethical line is not clear.

SYLLABUS STATEMENTS

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