rev 8-29-17

ASEN 5158
SPACE HABITAT DESIGN

Fall 2017
Tuesday/Thursday 2:00-3:15
Room ECCR 1B51

Distance Learning via http://www.colorado.edu/connect/

Instructor: Prof. David Klaus
telephone: (303) 492-3525
email: klaus@colorado.edu

Course Objectives

Utilize systems engineering methods to design and analyze a spacecraft intended for human occupancy and provide a functional knowledge of the technologies used to sustain life. Emphasis is placed on deriving requirements from stated mission goals and objectives, developing integrated functional schematics into a conceptual design, and comparing design options by trade study and mass estimation.

Office Hours

'*to be announced*' and weekly meetings with design team groups

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Textbook (optional now, currently out of print, notes will be provided)

Human Spaceflight Mission Analysis and Design, eds. Larson and Pranke, McGraw-Hill (any version ok)

Topics (*subject to minor revision during the semester*)

Introduction to Human Spaceflight – Ch 1
Human Space Mission Objectives – Ch 2
Space Environments – Orbit, Planets and NEO's – Ch 3, 4
Human Physiology – Ch 5
Ergonomics, Human Factors and Psychology – Ch 6, 7

Exam 1 ~ *Requirement Drivers / Oct 3*

Systems Engineering Terminology, Definitions, Acronyms and Design Phases
Deriving Requirements and Constraints from the Mission Goals
Ground Rules and Assumptions
Concept of Operations

Orbit Selection – Ch 9
Entry / Descent/ Landing / Ascent – Ch 10

Functional Decomposition
Minimum Functionality Design Approach – *Physics & Physiology*
Trade Space Cost-Benefit Analysis – *Safety & Operability*

Defining and Sizing Spacecraft Elements – Ch 11, 12, 13
- Human-Rating Process – *Accommodate, Utilize and Protect*
- 'Human in the Loop' Design Drivers
- Determining Habitable Volume

Environmental Control & Life Support System (ECLSS) Functions & Enabling Technologies – Ch 17
- Atmosphere Management
- Water Management
- Food Supply
- Waste Processing

Crew and Payload Accommodations (CA / PA) – Ch 18
Spacesuits and Extravehicular Activity (EVA) – Ch 22

Exam 2 ~ *Design Process / Nov 14*

Functions, Integration and Interfaces summarized for the following remaining spacecraft subsystems
- Structures – Ch 21
- Command, Control and Communication (C3) – Ch 27
- ADCS / GNC – Ch 19
- Power – Ch 20
- Thermal Control – Ch 16
- *in situ* Resource Utilization (ISRU) – Ch 15
- Spacecraft Propulsion – Ch 24
- Launch / Transfer Systems – Ch 25

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
- Requirement Compliance Verification and Design Validation
- CAD, Mockups, Prototypes, Test Articles, Flight Certification
- Launch & Mission Operations

Final ~ *Group Project Report and Presentation / Tuesday Dec 19, 1:30-4 pm*

Grading

20% on Homework, Quizzes & Participation, 40% from 2 Exams (20% each), 40% from Group Project (with individual weighting as warranted)
Finals Week – Group Project Presentation (with incremental reviews throughout the semester)

See Grading Policy Notes for additional information

See Additional Syllabus Notes for policies on Disabilities, Absences, Behavior and other Guidelines

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