SD2905 Human Spaceflight

Welcome to the fist lecture of the first edition of this course about people in space, vehicles in space and exploration!

Introduction 21-Jan-2014

- Basics about the course
- What's needed to send people to space? (Discussion)
- Introduction to the project work
- Example of a space mission (STS-116 in Dec 2006)

Learning outcomes

The general aim of the course is to give the course participants a good understanding of most aspects of manned space transportation with ability to analyse questions related to vessels and the role of humans in space.

- Account for the manned space vehicles that have been used and analyse specifically which problems they have had.
- Account for design demands that are set on manned space vehicles and explain the reasons for them. Analyse different technical solutions that have been used or been suggested. This both regarding launchers, life-sustaining systems on the space station and space suits.
- Account for the medical effects of space travels and the methods for reduction of these that are used.
- Analyse the general research fields that draw use of experiment in zero gravity and give some specific example of experiments.
- Analyse the role of astronauts.
- Discuss the economical and political factors that influence manned space transportation.

Course Basics (see also handouts)

- Lecture plan
  - Guest lecturer
- Course literature
- Exam
- Evaluation/grades
- Project work
  - The challenge
  - Mentors
  - Presentations
- Possibility to visit European Astronaut Centre in Cologne

Lectures

Date	Content	Comment
Tu 21/1	Introduction, course overview, project work, a mission video	
Fr 24/1	History of human spaceflight (with some emphasis on accidents)	
Tu 28/1	The space environment (of particular importance for humans)	
Fr 31/1	Medical aspect of human space flight	Patrik Sundblad
Tu 4/2	Requirements on space vehicles for humans (launch, in-orbit, landing)	
Th 6/2	Life support systems NOTE: Lecture on normally group work time!!!	Christophe Lasseure
Tu 11/2	The International Space Station: construction and operation	
Fr 14/2	Research on ISS and in µG	
Tu 18/2	EVA	
Fr 21/2	Mission analysis	
Tu 25/2	Political, economic and societal aspects of human space flight	Panel debate
Fr 28/2	Astronaut selection and training	Hans Bolender
Tu 4/3	Spare lecture TBD content	
Fr 7/3	Workshop	

Guest Lecturers

Patrik Sundblad

Medical Doctor with PhD in the area of cardiovascular physiology, with a general interest in Environmental Physiology and a specific interest on effects of gravity (and absence thereof). P. Sundblad has worked at the European Space Agency (ESA) for 10 years, and among various tasks has led the ESA Life Science unit and the human research unit. Currently employed as researcher at KTH at the Swedish Aerospace Centre, and is still involved in the management of European human research in the International Space Station.

Christophe Lasseure

PhD in Bio-engineering in the area of higher plant cultivation for Space life support system.
Works for ESA since 20 years, at ESTEC (European Space Technology Centre) in Noordwijk, the Netherlands.
Life Support R&D coordinator.
MEliSSA (Micro-Ecological Life Support System Alternative) project manager

Hans Bolender

Works for ESA at EAC (European Astronaut Centre) in Cologne, Germany.
Head of ESA's Astronaut Training Division

Feedback/summary lecture notes

This is a new course. Sorry, you are guinea pigs – like any astronaut in space☺
Please, give a lot of feedback!
Indeed, I'm asking you to after each lecture write a short note:

- Most important concept of the lecture, what you want to take with you for the future
- What could be skipped (if anything)
- What did you miss

If you hand in at least 10 lecture feedback notes you can earn a bonus credit towards a higher grade.

Literature

”Human Spaceflight and Exploration”, Springer-Verlag

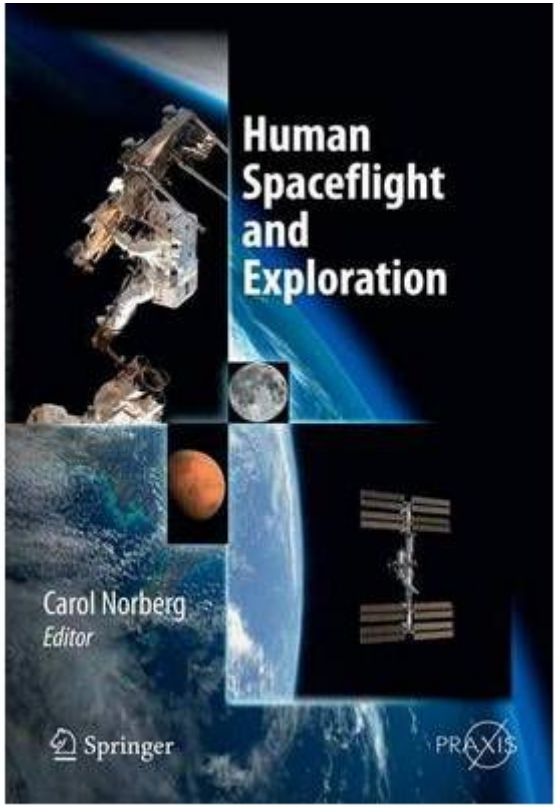
Carol Norberg, Editor and main contributor

Additional contributors: Sven Grahn, Åke Ingemar Skoog, Hansulrich Streimle, Gerhard Thiele (and very minor Christer Fuglesang)

Available at student’s expedition* Teknikringen 8 for ca 750 SEK

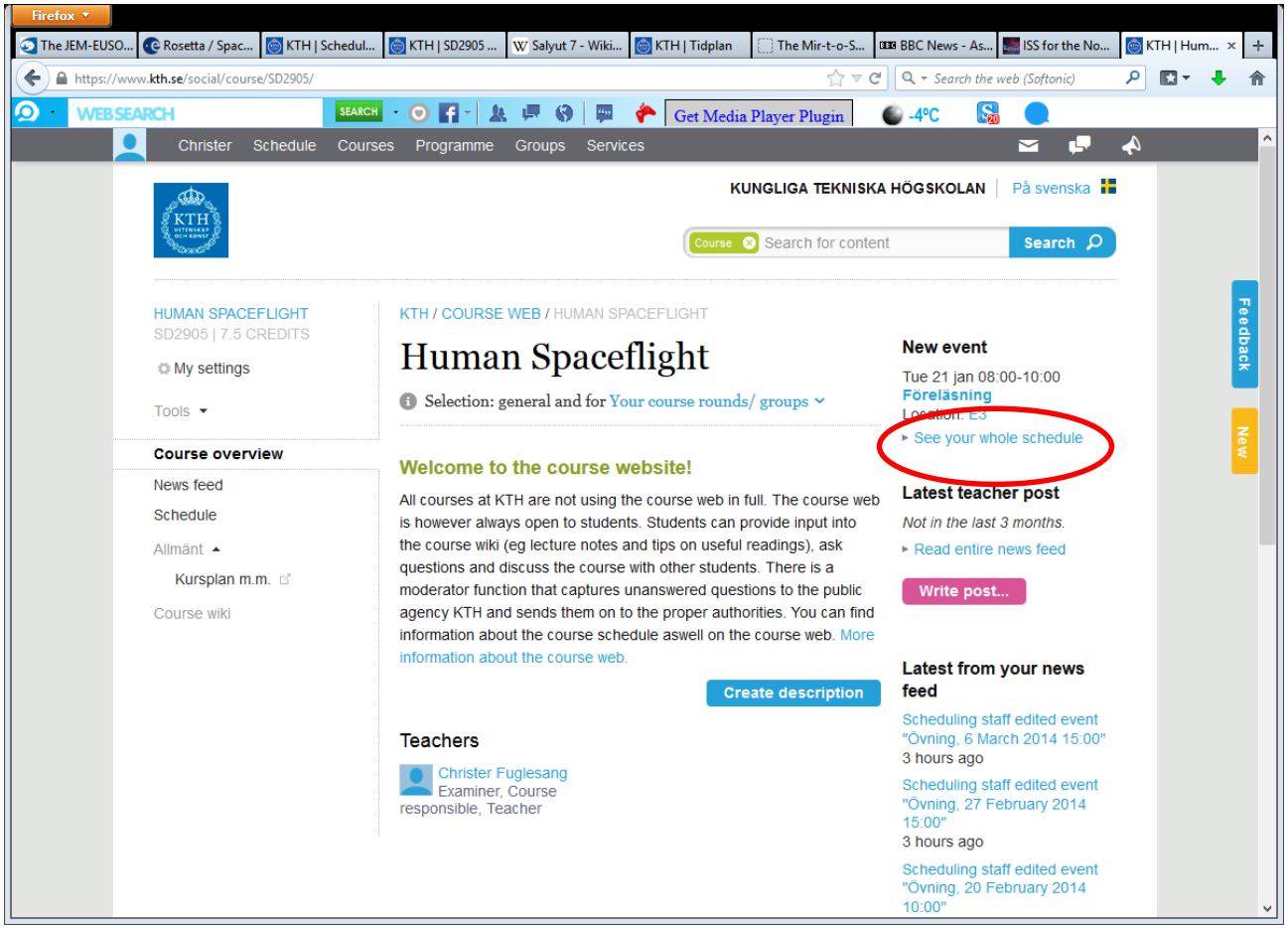
E-book from Springer

E-book at KTHB



* Only a few books in stock! Let me know if you want me to order. (ca 4 days delivery time)

KTH Social Website



Lecture hall change: Mostly Hugin (Teknikringen 8), E33 on 31/1
Excersice classes in E51 and E52

Grades and exam

Project work: The requirement to pass this part is that you have participated actively in the group's work and that the group's report is approved. Credits are given by the following scales:

- Written group report will give credits 0 (Not approved), 1 (Approved) or 2 (Approved with Honors). All group members will get the same rating.
- The oral presentation will give 0 (did not participate during most of the Workshop) or 1 (participated)

Written exam: The requirement to pass this part is that the exam in approved (about 50% right answers). Credits are given by the following scale:

- Not approved (less than about 50% correct answers) 0 credit
- Approved (more than about 50% correct answers) 1 credit
- Approved with Honors (more than about 75% correct answers) 2 credits

Bonus credit for active participation during the lectures:

If you have been at least somewhat active during the lectures and handed in at least 10 (of 13 possible) feedback&summary forms after the lectures, you will receive 1 bonus credit. To be counted, the forms must be handed in no later than the day after the lecture.

The final grade is given by the table below, however both the written examand the project work must have passed to obtain any grade above Fx:

Grade	Credits	Meaning
A	6	Excellent
B	5	Very good
C	4	Good
D	3	Satisfactory
E	2	Sufficient
Fx	1	Fail. More work required to obtain the pass grade E
F	0	Fail

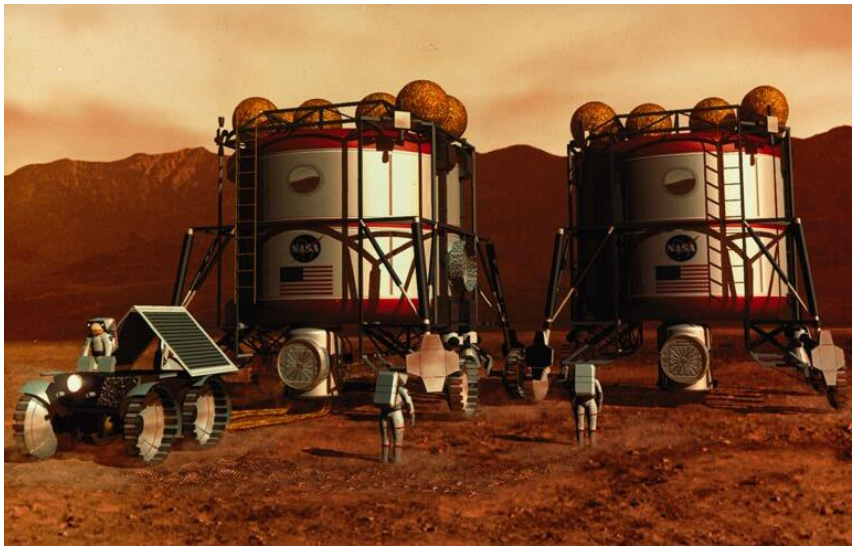
What is needed to send people to space?

To keep people alive in space and bring them back?

Let’s discuss!

Project work:

Design the first human mission to the planet Mars!



This journey is assumed to be the first manned mission to Mars in a much broader program with the main objective to build a research base. Ultimately this could lead to permanent habitation of humans on Mars.

The mission shall be designed from ground on Earth to Mars and back. All crew members who leave for Mars shall sooner or later be assumed to return to Earth alive. Some, but not necessarily all, shall land on Mars and execute research tasks there.

Team work and Group work

Two teams: ”Red Team” and ”Blue Team”

Each team consists of 4 or 5 groups, of 4-5 students:

1. Overall mission coordination
2. To and from the surface of the planets
3. The transplanetary vehicle
4. On Mars
5. The research program (en-route and on Mars)

(If only 4 groups: No. 4 and 5 are merged.)

Scope and expectations

- Limited – show a concept that holds together and could *in principle* work.
- Make your own assumptions, and extrapolations of technology – but be prepared to be challenged!
- Some aspects to consider, or at least comment upon:
  - Big picture mission overview
  - Vehicles (types, size,…)
  - Crew composition
  - Life support systems and human behavior support
  - Communication (data, voice, commands ...)
  - Thermal, attitude, propulsion, on board power
  - Mass budgets and logistics
  - Research tasks on Mars as well as en-route.
  - At least one “off-nominal” (“what-if”) case shall be addressed by each group.
- Order-of-magnitude cost estimate.
- Bonus: How to ”sell” the mission to the public?

Mentors for the Project work

Sven Grahn

svengrahn@bahnhof.se

Education

☐ Master of Science degree from the School of Engineering Physics at the Royal Institute of Technology,1969.
☐ Sixty Academic credits in meteorology, University of Stockholm

Professional Experience

Institute of Meteorology, University of Stockholm (1962-1975)

☐ Rocket assembly technician during the sounding rocket launchings from the Kronogård rocket base in northern Sweden during the summers of 1962-64.

Swedish Space Corporation (1975-2006)

☐ 2006-2011 Senior Adviser to the SSC, having retired my full-time job at SSC. I am now an independent consultant.

Teaching experience

☐ I served on the faculty of design projects during summer session programs of the ISU in 1994 and 1995.

Nils Pokrupa

nils.pokrupa@ohb-sweden.se

Education

Masters of Science in Space Engineering, Umeå University, Kiruna, Sweden, 2006
Bachelor of Aerospace Engineering with High Distinction, Carleton University, Ottawa, Canada, 2000

Professional Experience

2011-present: OHB Sweden, Stockholm, Sweden: Head of Spacecraft Department and Project Manager
2006-2011: Swedish Space Corporation, Stockholm, Sweden Spacecraft Systems Engineer
200-2004: BRISTOL AEROSPACE LIMITED, Winnipeg, Canada Mechanical / Thermal Design Engineer

Emil Vinterhav

Emil.Vinterhav@sscspace.com

Education

Master of Science, Engineering Physics, Lund Institute of Technology November 98
Bachelor of Economics, Lund University June 00

Professional Experience

March 2013 – present: ECAPS AB; Project Management and Business Development related to development and marketing of ECAPS green propulsion technology HPGP.
2011-2013: OHB Sweden AB
1990-2011: SSC AB

About the team and group work

- Mentors NOT project leads
- Mentors will help the teams to get organized and started, to give advice and ideas and to be around for discussions and to answer questions.
- Groups to have at least one “formal” meeting per week, with short notes taken. A chair and secretary for each meeting. The notes to be sent to the mentors and examiner within a day.
- Roles of chair and secretary to rotate in the group so all will have each role at least once. See appendix in handouts.

Project work presentation

- Workshop on Friday March 7th
  - Preliminary results
  - Each group present during 15 min. At least 2 group members talk.
  - Non-presenting team to give comments, criticism and constructive feedback.
- Final written report due Friday March 21st
- Option: Poster

Now – Let's prepare and do a space mission!