PHYS 795/895
ME 795/895
EOS 895

Satellite Systems and Instrumentation

Spring Semester 2009

Time:	12:40 - 2:00 PM Tuesday, Thursday *Times may change due to conflicts of some students!*
Location:	Kingsbury N133
Instructor:	Prof. Marc Lessard Physics Department and Institute for the Study of Earth, Oceans and Space
Office:	Morse Hall, Room 417 Phone 862-2590 E-Mail: Marc.Lessard@unh.edu
Office hours:	TBD
Instructor:	Prof. Harald Kucharek Physics Department and Institute for the Study of Earth, Oceans and Space
Office:	Morse Hall, Room 412 Phone 862-2948 E-Mail: Harald.Kucharek@unh.edu
Office hours:	Mo: 3:00 - 4:00 PM, We, Tu: 3:00 - 4:00 PM, after class
Instructor:	Prof. May-Win L. Thein Department of Mechanical Engineering
Office:	W117 Kingsbury Hall Phone 862-1158 E-Mail: mthein@cisunix.unh.edu
Office hours:	Mo, We, (Fr – by request): 1:10-2:00 PM, or by appointment

Satellite Systems and Instrumentation

M. Lessard
H. Kucharek
M-W. Thein

Textbooks:

"*Fundamentals of Space Systems*"
Vincent L. Pisacane (2nd Edition)
JHU/APL in Science and Engineering, Oxford press.

"*Space Mission Analysis and Design*"
James R. Wertz and Wily J. Larson (3rd Edition) Space Technology Library, Microcosm Press, Springer

"Modern Spacecraft Dynamics and Control"
Marshall H. Kaplan
John Wiley and Sons

Information material: Presentation material, Lecture Notes, and other course related materials will be on the www through "Blackboard".
Go to: http://www.unh.edu/blackboard/gettingstarted.html
for a first overview, and save the Student Manual to your computer.

Homework: (tentatively) when projects are not assigned, will be given weekly, assigned Thursday, due following Thursday

Grading: Based on:

Class Room activity incl. oral presentation of homework, short tests on reading *Graduate Students* need to present 1 Lecture for Credit! *Undergraduate Students* can earn Bonus Points for 1 Lecture or essay on a course related topic	15%
Homework	15%
Term Papers and Short Projects	25%
Mid Term Exam (1&2)	20%
Final Exam	25%

Book List

Course Book:

"*Fundamentals of Space Systems*"
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James R. Wertz and Wily J. Larson (3rd Edition) Space Technology Library, Microcosm Press, Springer

"Modern Spacecraft Dynamics and Control"
Marshall H. Kaplan
John Wiley and Sons

Other Textbooks:

"System Dynamics"
Katsuhiko Ogata (4th Edition)
Prentice Hall

"Space Vehicle Dynamics and Control"
Bong Wie
AIAA Educational Series

Additional information on special topics:

PHYS 795/895
ME 795/895
EOS 895
Overview

Goals

This course addresses Physics and Engineering Seniors, as well as entering Graduate Students. It is designed to provide an overview of modern space missions and space instrumentations used in near Earth, heliospheric, and interplanetary missions. This course is being taught under the assumption that the students are familiar with the concepts of

- Classical Mechanics
- Electrodynamics
- Thermodynamics
- Trigonometry and Calculus

It is the goal to apply these concepts towards understanding the basics instruments used on spacecrafts and rockets, mission planning, mission control, and launch vehicles.

Expectations

The course consists of lectures, term papers, short projects, activities, and homework. The homework plays an essential role in covering the material. Tentatively, graduate students are also expected to present one class of the course to receive credit. Undergraduate students may also tentatively choose to present one class for extra credit. We will assist in the preparation of the class and welcome the use of lecture notes.

Term Paper and Short Projects

In addition to the regular homework each student will have to write a paper about lecture related topic (typed, with a length of ≈ 5 pages). The paper should concentrate on the basic physics concept of an instrument, a concept study of a mission, or a payload concept for a satellite. A draft is due by mid April. We will grade the draft for 75% of the credit and discuss it with each student. A final version is due by the last day of class for the remaining 25% of the credit. Short projects will also be assigned in addition to (or in lieu of) regularly assigned homework. These project(s), like homework, play an essential role in covering class material but will be more involved than the typical homework assignment.

Course Overview

Week 1: Introduction:
- mission types
- remote sensing
- global positioning system
- communications
- science missions: physics, astronomy, planets
- software: Satellite Tool Kit (STK)

Week 2: Mission design and planning:
- Satellites as systems
- Scheduling (project management)
- Trade studies, etc
- Mission phases
- Design and readiness reviews

Week 3: Environment:
- orbital environment
- launch environment: vibration and loads
- effects on materials and people
- outgassing

Week 4-6: Instrumentation:
- Basics: Geometric factors and Signal-to-noise ratio
- Noise or, gain, dynamic range, bit depth, etc
- Particle (including photon) detectors/imagers
- Electric and magnetic field instruments

Weeks 7-10: Spacecraft dynamics and control:
- Introduction to system dynamics and control
- Attitude dynamics
- Attitude determination and control
- Orbital transfers and control

Week 11: Rocket and spacecraft propulsion
- rocket engines/performance
- launch vehicles
- spacecraft propulsion
- ion thrusters

Weeks 12: Electrical systems:

- communications
- telemetry and link budget
- power systems
- data storage and handling
- spacecraft bus design

Week 13: Mechanical systems and thermal control:

Mechanical Systems:

- structural design
- materials
- robotics, pyrotechnics

Thermal control:

- radiative and conductive heat transfer
- spacecraft energy balance

Week 14: Testing:

- environmental testing
- deployment testing

Week 15: Applications revisited:

- remote sensing
- global positioning system
- communications