Gateway To Space

ASEN / ASTR 2500
\[ \frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} + \frac{\partial^2 \phi}{\partial z^2} = 0 \]

\[ \sum_{k=1}^{n} k^2 = \frac{n(n + 1)(2n + 1)}{6} \]

\[ \frac{d}{dx} f(x) = \lim_{\Delta \to 0} \frac{f(x + \Delta) - f(x)}{\Delta} \]

\[ \cos x = \sum_{n=0}^{\infty} \frac{(-1)^n x^{2n}}{(2n)!} \]

\[ \int \tan(ax)dx = -\frac{1}{a} \ln|\cos(ax)| + c \]

\[ \int u \frac{dv}{dx} dx = uv - \int \frac{du}{dx} v dx \]

\[ \lim_{x \to c} \frac{f(x)}{g(x)} = \lim_{x \to c} \frac{f'(x)}{g'(x)} \]

\[ \lim_{x \to \infty} \tan^{-1}(x) = -\frac{\pi}{2} \]
PID Control Law

- Proportional, Integral, Derivative (PID)
  - Used to control single axis
  - One PID controller for each axis

\[
\begin{align*}
\omega_{err} & \xrightarrow{K_d} \text{Rate Gain} \\
\theta_{err} & \xrightarrow{K_p} \text{Att Gain} \\
\int \theta_{err} & \xrightarrow{K_i} \text{Int Att Gain}
\end{align*}
\]

\( \omega_{err} \) = rate error
\( \theta_{err} \) = attitude error
\( \theta_{i_{err}} \) = integrated attitude error
PID Control Law Response Times

Zero Rate Gain = No Damping
Small Rate Gain = Light Damping
Large Rate Gain = Heavy Damping
Gateway To Space

ASEN / ASTR 2500

Class # 01

Colorado Space Grant Consortium
How was the first day?
Space?
Today

- Introductions

- What to expect from this course

- Format for this course

- “How to get an A”

- Pictures

- Space Grant Introduction
Introductions
Who is this Guy?
Who is this Guy?
Who is this Guy?

I live in Arvada, 2 miles east of HWY 93
Who is this Guy?
Who is this Guy?

Graduated from CU in December 1992 with B.S. in Aerospace Engineering

Graduated from CU in December 1994 with M.S. in Mechanical Engineering
What Experience Do You Have?

Intern at Ball
summer of 1991

Worked with
Bob Poley

Worked on
RADARSAT
What Did You Do After College?

Worked at Lockheed Martin from March 1995 until May 2000
What Did You Do At Martin?

- Classified satellite
- 1,000 people on program
- Youngest
- Reaction Control System
- Mechanical Design Lead
- Design done in IDEAS
- Released over 100 engineering drawings

- Supervised manufacture, assembly, integration and test for 5 satellite builds
- Last two years, Mechanical Design Lead for the Antenna systems
What Did You Do At Martin?

- Also worked on Stardust and Genesis

- Worked with many different disciplines and people
Why Did You Leave?

- Many reasons

1. Coming back here was a great opportunity

2. Pictures on the wall

3. Mentor

4. Change
Who is this Guy?

- 10th time teaching this course

- I have a unique teaching style
  - I teach like I wish I had been taught
  - Sense of humor
<p>| | | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>36</td>
<td>My age</td>
<td></td>
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<tr>
<td>23</td>
<td>The age I feel</td>
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<tr>
<td>6</td>
<td>Hours I get to sleep a night</td>
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<tr>
<td>48</td>
<td>Hours I get to sleep a week</td>
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<tr>
<td>60</td>
<td>Average number hours I work a week</td>
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<tr>
<td>5</td>
<td>Hours per week I am paid to teach this course</td>
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</tr>
<tr>
<td>15</td>
<td>Average hours per week I actually spend on class</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Times I have taught this course</td>
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<tr>
<td>140</td>
<td>Emails I get each day</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>You</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Me</td>
<td></td>
</tr>
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</table>
Your Turn
Today

Space…

So why are you here?

We are going to do the following…
1. Stand up
2. Say your name
3. Tell me what you hope to learn in the class
4. Why you took the class
So Why Are You In College?
Space in Colorado:

- $9.7 Billion
- 142,500 Coloradoans
- Expected to double in 2010
- “Graying of the workforce”
Why You Are Here:

- You like Space (Star Trek, Star Wars, etc.)
- You want to get a good job after college
- Good School
- Good Grades
- Good Experience
- This course and Space Grant gets you all three
- Unique point in your life!
What To Expect
The Class:

**Learn** the basics of atmospheric and space sciences, space exploration, spacecraft design, rocketry, and orbits.
The Class:

Hear about the current research in space through lectures from Lockheed Martin, Ball Aerospace, LASP, NOAA, NCAR, and CASA.
Launch a mini-satellite on a high altitude balloon that is designed and built by you and a team of students.
The Class:

- Interactive
- Interesting
- Applicable
- Fun
What to expect from this class:

- Plan on being here for the full class (75 minutes)

- Be ON-TIME

- 1 Minute Reports Each Class

- Attendance

- No cell phones or laptops

- Homework (Only 6)

- A lot of work
What to expect from this class:

- If you are not here because you want to be here, then leave…

- You will work hard if you stay

- No Slackers Welcome

- Student Expectations from last spring
Syllabus
How to get an A
How to get an A:

“Everyone starts out with an A”

You have to try really hard to get anything lower than C-

Not in the business of giving bad grades…

…But you get the grade you earn

Don’t Cheat
How to get an A:

Grades are based on a normal 100 point scale

There is no curve

Team project and participation are based on your team evaluation and instructor evaluation

Feedback will be slow

Grader – Noah Moore
How to get an A:

Grade Breakdown

- 30% Coursework
  - Attendance (33)
  - 1 Minute Reports (~30)
  - Homework (1-4,6)
  - Community service (1)

- 5% Homework 5

- 15% Final Exam

- 10% Team Proposal

- 9% Team Presentations (3)

- 5% Team Design Document (3 Revs)

- 12% Team Project and Participation

- 14% Final Team Report & Presentation

50% You 50% Team
Miscellaneous:

- Get involved now

- Just Do It

- Attendance will be taken (Signing for friends)

- Coming in late…

- Communications via email and this class

- Travel and sick
Miscellaneous:

- Mutual Respect “Shut up and be quiet”

- Class seating, move to the front of the room

- Clap and questions

- Office hours 11-12 T and R and by appointment

- Where to Find Me…

- Notes – Take them

- Book for course
Miscellaneous:

Book for course

- Typical engineering book cost $100, $90, $80, $70

This Book…
- $13.95
- Rocket Boys
  Homer Hickam

Also…Set aside $50 for project
### Rocket Boys: A Memoir (Paperback, 2000)

**Author:** Homer Hickam  
**Best Price:** $1.50  
**List Price:** $13.95 (Save 89%)

#### Brand New Items

<table>
<thead>
<tr>
<th>Price</th>
<th>Seller</th>
<th>Comments</th>
<th>Shipping</th>
<th>Ships From</th>
</tr>
</thead>
</table>
| $2.99 | **expressquality**  
(381 ⭐️ 99%) | No Spine Creases or Edge wear                 | Media Mail  
Upgrade          | OH         | [More info...](#) |
| $3.00 | **live-love-learn!**  
(29 ⭐️ 93%) | 100% NEW Rocket Boys paperback novel! Don't miss picking up this one | Media Mail          | OH         | [More info...](#) |
| $3.99 | **cunard-whitestar**  
(924 ⭐️ 99%) |                                              | Media Mail  
Upgrade          | MA         | [More info...](#) |
| $4.00 | **new-2-this**  
(18 ⭐️ 100%) |                                              | Media Mail          | VA         | [More info...](#) |

*Actual items for sale may vary from the above information and image.*
1 Minute Report:

Name:
Date:
Lecture Title:

1. Key points of today’s lecture?

2. What wasn’t clear and/or what questions do you wish you had asked?

3. What personal contributions have you made to your team this week?

4. What grade would you give today’s lecture?

5. Other comments, concerns, or suggestions?

Gateway to Space
1 Minute Report
Homework
Homework:

Submit via email

- Subject should be in this format
  “HW_{XX}\_Lastname\_Firstinitial.doc”

- Get from Website

First Homework is…
Questions?
Final Word

You’ll Never...
Experience Matters:

Satellite Took Kit
Experience Matters:

Galileo Mission Control (Just before Crash into Jupiter)
Experience Matters:

Space Station Robot Arm (Johnson Space Center)
Experience Matters:

Chandra Mission Control
Experience Matters:

Mars Observer
Experience Matters:

Mission Control (Johnson Space Center)
Experience Matters:

Mars Exploration Rover (JPL)
Experience Matters:

Kennedy Space Center (Shuttle in background)
Experience Matters:

Mars Exploration Rover
Experience Matters:
Experience Matters:

Mars Exploration Rover
Experience Matters:

Mars Exploration Rover
Space Grant?
Space Grant is National

YEAR 2000 MAP OF NASA SPACE GRANT/EPSCoR AFFILIATES

- NASA Space Grant consortia
- NASA Space Grant/EPSCoR funded consortia
- NASA Space Grant/EPSCoR eligible consortia

Total number of affiliates = 725
Some symbols reflect multiple sites
Space Grant is Colorado

- Colorado State University
  Fort Collins
- Colorado School of Mines
  Golden
- University of Northern Colorado
  Greeley
- University of Colorado
  Boulder
- Front Range Community College
  Metro State College
  Denver
- United States Space Foundation
- Pikes Peak Community College
- United States Air Force Academy
- University of Colorado
  Colorado Springs
- University of Southern Colorado
  Pueblo
- Fort Lewis College
  Durango
- Adams State College
  Alamosa
What is Space Grant?

Our Vision…

The Colorado Space Grant Consortium uses the excitement and opportunities provided by the nation’s aeronautics and space program to inspire, educate, and develop America’s future technological workforce by enabling a diverse community of students to participate in space-based projects, courses, and outreach activities.
Space Grant is Students
Design

Teaching:

Outreach:

Research:

Networking:

Concept

Analysis

Operations

Develop

Flight

ACADEMIA

GOVERNMENT

INDUSTRY

NATIONAL CONSORTIA

COLORADO SPACE GRANT COLLEGE
Past Research Programs
Student Research Projects
Student Research Projects
Student Research Projects

DINO (Deployment and Intelligent Nanosat Operations)
Student Research Projects