



Overview & Introduction
Lecture 1

ME 231: Dynamics

Question of the Day

What is dynamics
& why is it
important?

About 2×10^6 results on Google books
from the past two years alone

The screenshot shows a Google Books search interface for the term "dynamics". The search results are displayed in a grid format, showing book covers, titles, authors, and page counts. The search bar at the top contains the word "dynamics" and a "Search" button. The left sidebar includes navigation options like "Everything", "Books", and "More", along with filters for "Browse Books", "Any view", "Any document", "Books", "Magazines", "List view", "Grid view", "Any time", and "Custom range...". The search results include:

- Dynamics** by Peter Guthrie Tait, 2009, 376 pages.
- DYNAMICS** by Horace Lamb, 2009, 368 pages.
- DYNAMICS: A Text-Book for the Use of the Higher Divisions in ...** by Arthur Stanley Ramsey, 2009, 280 pages.
- GROUP DYNAMICS** by Doneison R. Forsyth, 2009, 680 pages.
- Fluid Dynamics: Theory, Computation, and Numerical Simulation** by Constantine Pozrikidis, 2009, 773 pages.
- Dynamics** by Charles V. Burton, 2009, 320 pages.
- Complex Dynamics** by Dierk Schleicher, 2009, 635 pages.
- Stochastic Dynamics of Structures** by Jie Li, Jianbing Chen, 2009, 384 pages.
- Economic dynamics: theory and computation** by John Stachurski, 2009, 373 pages.
- Nonlinear magnetization dynamics in nanosystems** by Giorgio Bertotti, I. D. Mayergoyz, Claudio Serpico, 2009, 466 pages.
- Computational Fluid Dynamics 2008. Proceedings of the Fourth ...** by Herman Deconinck, E. Dick, 2009, 893 pages.
- Molecular Nano Dynamics: Spectroscopic Methods and Nanostructures ...** by Hiroshi Fukumura, Masahiro Irie, Yasuhiro Iwasawa, 2009, 740 pages.

The bottom of the page features the "Goooooooooogle" logo, a search bar with "dynamics" and a "Search" button, and links for "Search within results", "Search Help", "Give us feedback", "Google Home", "Advertising Programs", "Business Solutions", "Privacy", and "About Google".

Outline for Today

- Question of the day
- Who am I?
- Who are you?
- What is in the syllabus and handouts?
- Context: Why is dynamics important?
- Concept: What is dynamics?
- Calculation: How do we use dynamics?
- Answer your questions!

Who am I?

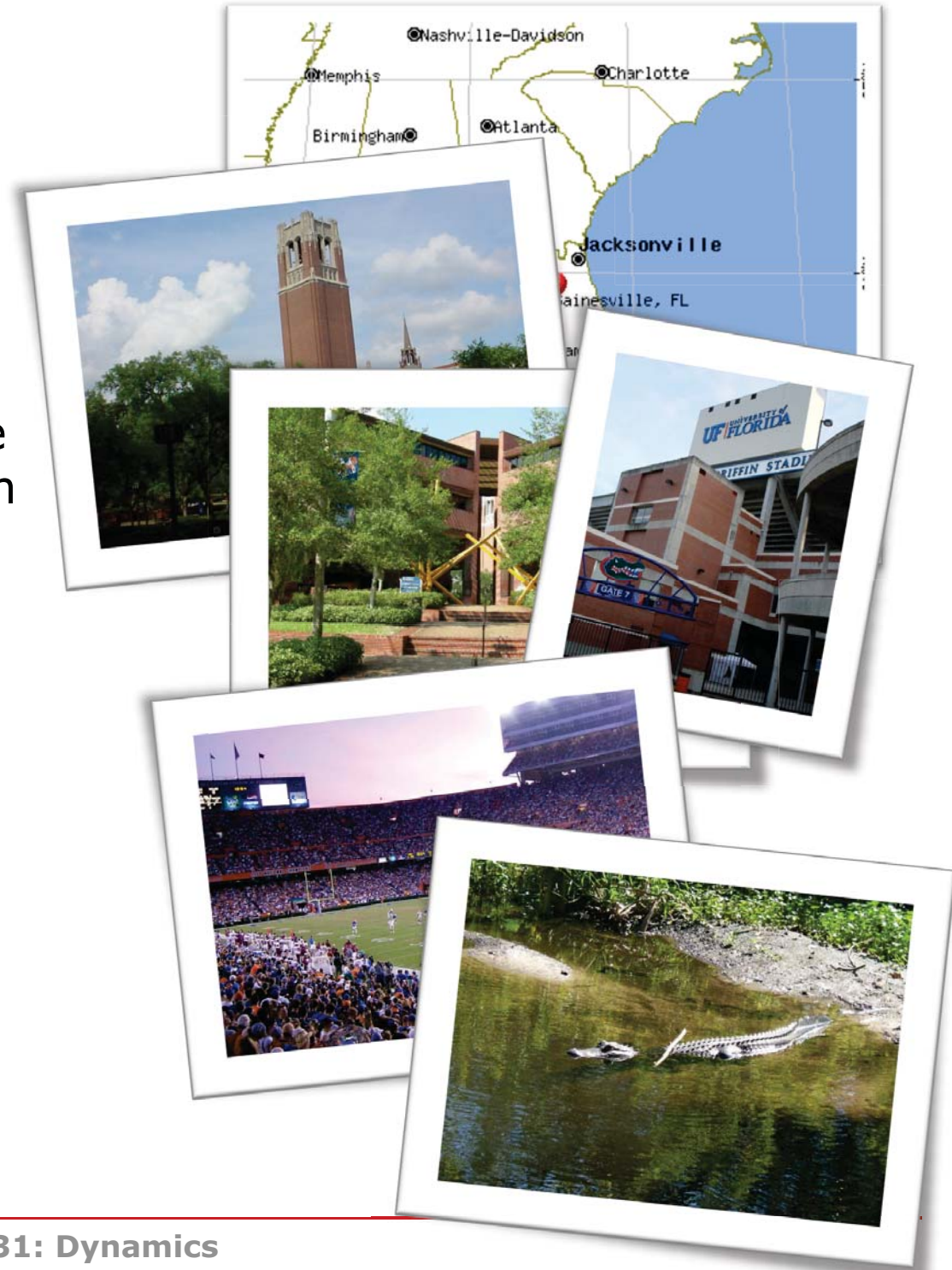


- Originally from Florida



Who am I?

- Originally from Florida
- B.S. in Engineering Science from University of Florida in 1996



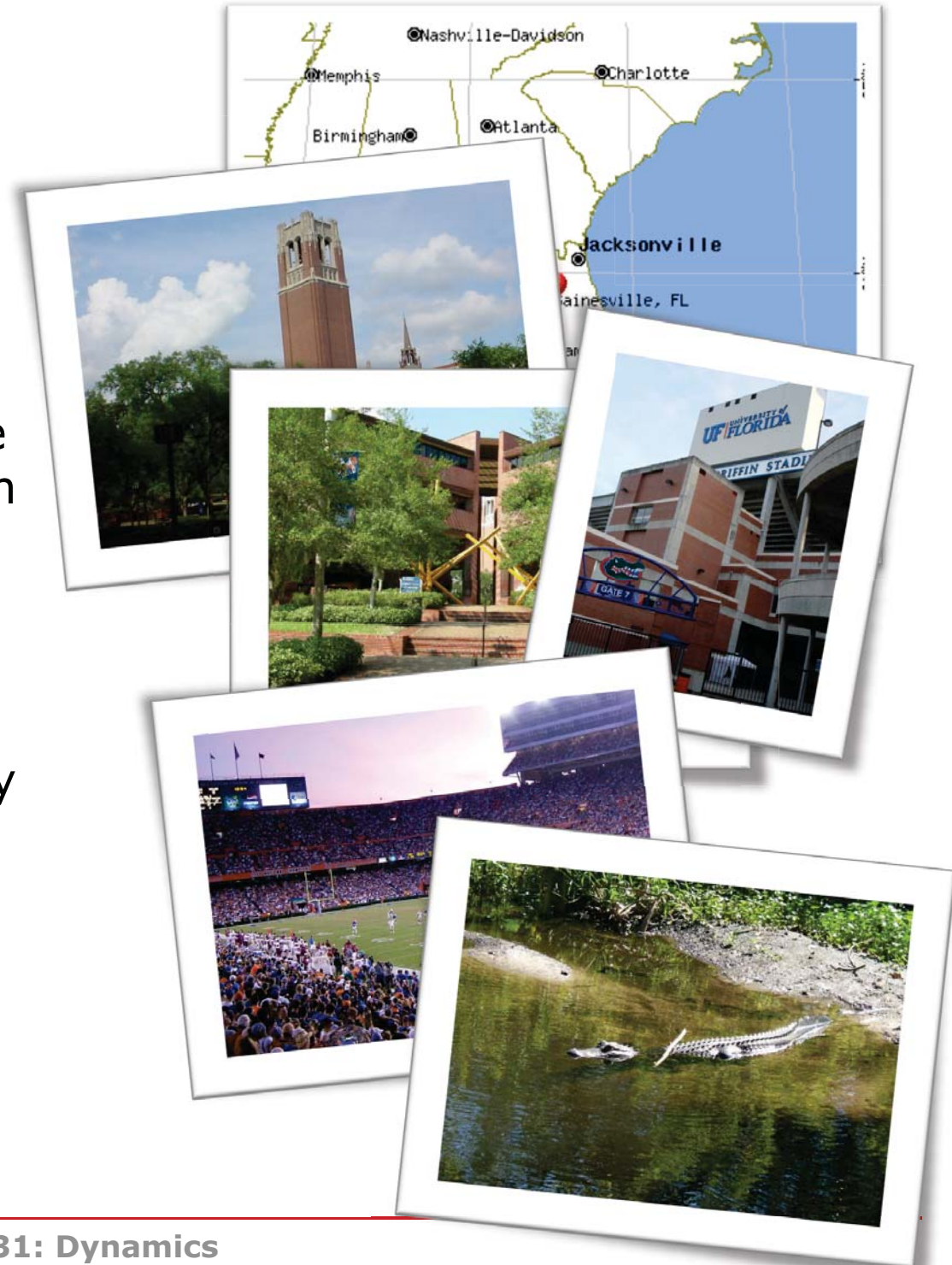
Who am I?

- Originally from Florida
- B.S. in Engineering Science from University of Florida in 1996
- Biomedical Engineer for Computer Motion, Inc.



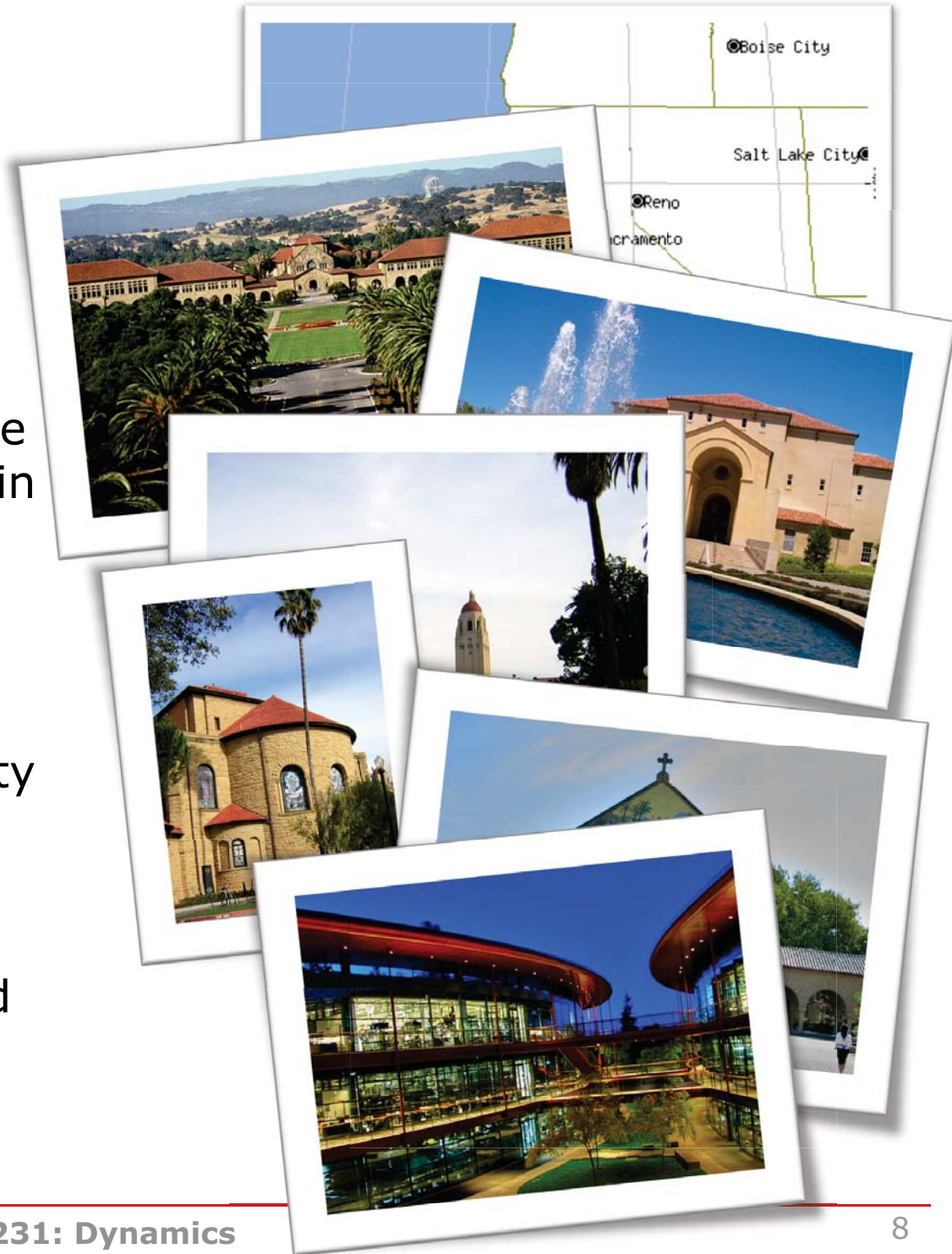
Who am I?

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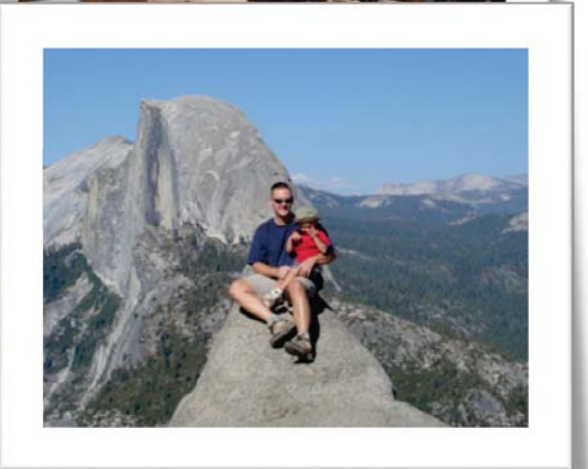
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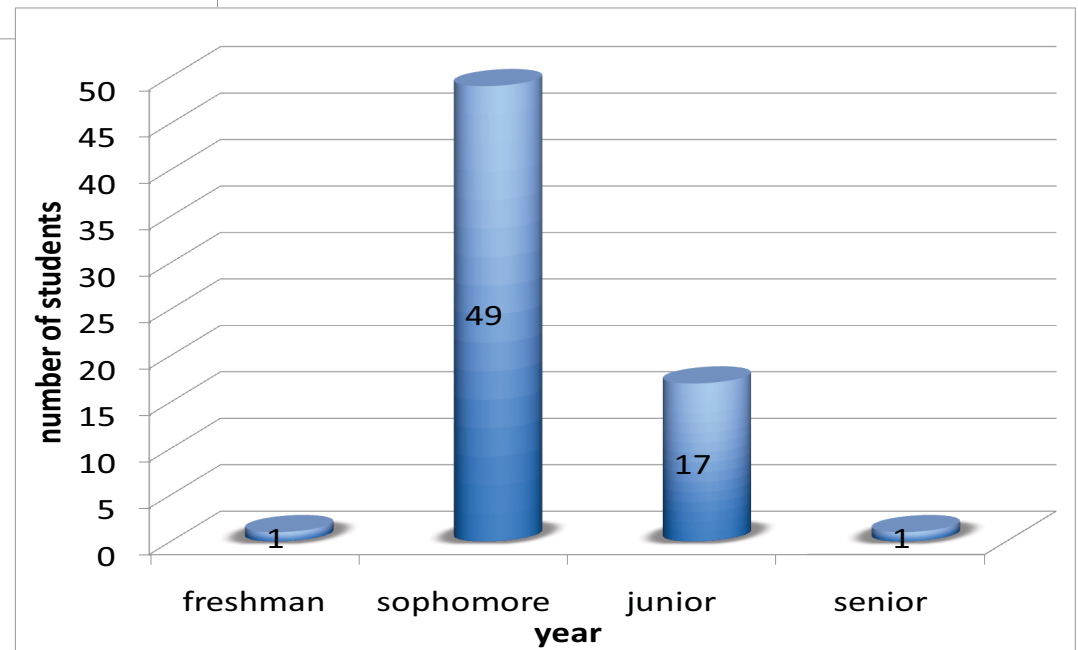
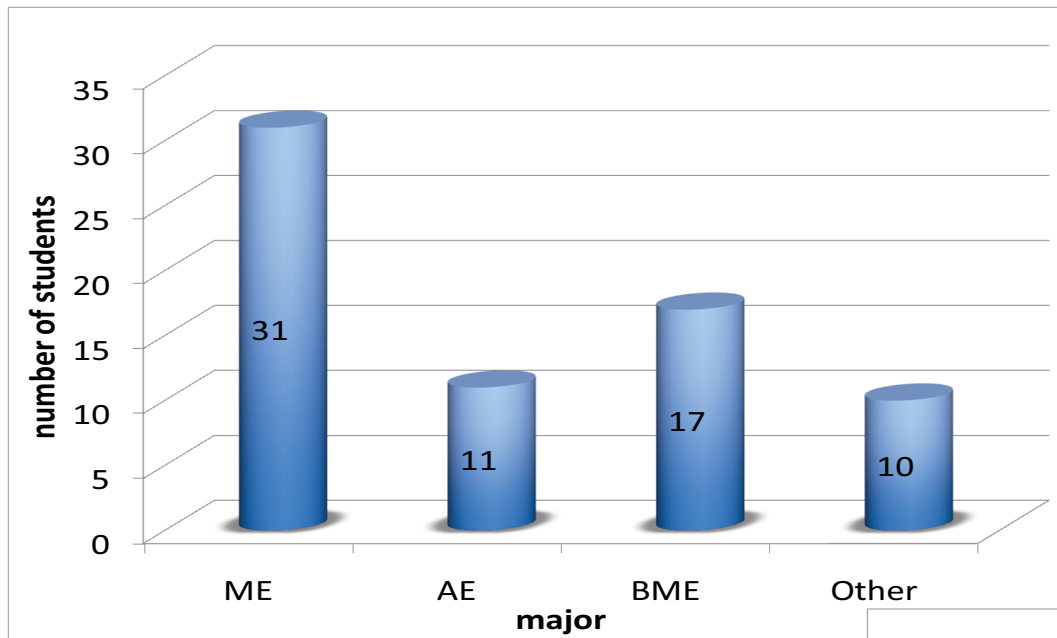


Who am I?

- Originally from Florida
- B.S. in Engineering Science from University of Florida in 1996
- Biomedical Engineer for Computer Motion, Inc.
- Ph.D. in Mechanical Engineering from University of Florida in 2006
- Postdoc & Engineering Research Associate in Bioengineering at Stanford
- Married with two children
- Enjoy learning, volleyball, biking, and being outdoors



Who are you?



Who are you?

1. Where were you born?
2. What is something unique about where you grew up?
3. What sports do you like?
4. Why are you taking dynamics?
5. What do you want to do after you graduate?

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- Answer your questions!

What is in the syllabus and handouts?



COURSE SYLLABUS **ME 231 ~ Dynamics** **Fall 2012**

Course Section: 001
Meeting Time and Place: 10:10AM – 11:00AM | MWF | Min Kao 524
Course Credit Hours: 3

FACULTY CONTACT
INFORMATION

Jeff Reinbolt
Office hours: 11:15AM - 12:05PM MWF
Office: DO 207
Phone: 865.974.5308
Email: reinbolt@utk.edu

TEACHING ASSISTANT CONTACT
INFORMATION

TBD

What is in the syllabus and handouts?

HOMEWORK ASSIGNMENTS ME 231 ~ Dynamics

Month		Monday		Wednesday		Friday
August	13		15		17	
	20		22		24	
	27		29	HW #1	31	
September	3	Labor Day (no class)	5	HW #2	7	
	10		12	HW #3	14	
	17		19	HW #4	21	
	24		26	HW #5	28	

What is in the syllabus and handouts?

HOMEWORK INSTRUCTIONS **ME 231 ~ Dynamics**

- Register for Connect using the following:

student registration information

course

Dynamics - ME 231

instructor

Jeffrey Reinbolt

section

Fall 2012 MWF 10:10am

What is in the syllabus and handouts?

EXAM DETAILS ME 231 ~ Dynamics

Exam	Chapters	Date	Time	Place
1	1, 2, 6	October 3, 2012	10:10-11:00AM	MK 524
2	3, 5, 7, 8	November 16, 2012	10:10-11:00AM	MK 524
Final	1-8	December 10, 2012	8:00-10:00AM	MK 524

What is in the syllabus and handouts?

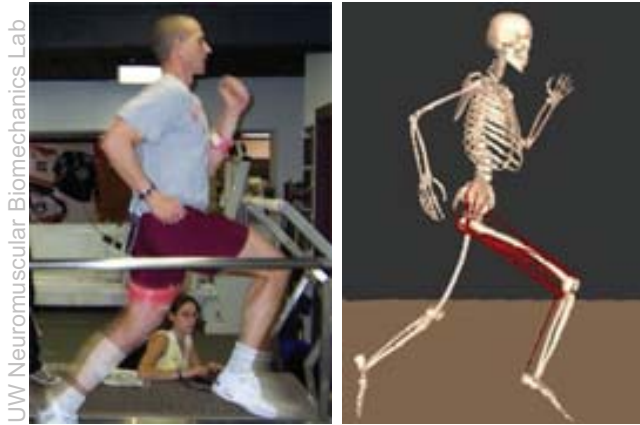
LECTURE SCHEDULE ME 231 ~ Dynamics

Month		Monday		Wednesday		Friday
August	13		15		17	
	20		22	Overview & Intro. 1.1 - 1.3	24	Rectilin. Motion 2.1 - 2.2
	27	Curvilin. Motion 2.3 - 2.4	29	Normal, Tangential 2.5	31	Polar 2.6
September	3	Labor Day (no class)	5	Space Motion 2.8	7	Relative Motion 2.7
	10	Constrained Motion 2.7	12	Rotation 6.1	14	Absolute Motion 6.1
	17	Relative Velocity 6.2	19	Instant Center 6.2	21	Relative Accel. 6.3
	24	Relative Accel. 6.3	26	Rotating Axes 6.4	28	Rotating Axes 6.4

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Context: Why is dynamics important?



Analyze and optimize athletic performance



Design ergonomically safe environments



Create human and animal characters



Understand and treat movement disorders

Context: Exercise & Discussion

Investigating the Spin Motion of the Dynamic Celt

clockwise = simple spin

counter-clockwise = simple spin



zero *product of inertia*

Context: Exercise & Discussion

Investigating the Spin Motion of the Dynamic Celt

clockwise = simple spin

counter-clockwise = **wobble and spin reversal**



negative *product of inertia*

Context: Exercise & Discussion

Investigating the Spin Motion of the Dynamic Celt

clockwise = **wobble and
spin reversal**

counter-clockwise = simple spin



positive *product of inertia*

Concept: What is dynamics?



Merriam-Webster
OnLine

Main Entry: **dy·nam·ics** 

Pronunciation: \dī-'na-miks\

Function: *noun plural but singular or plural in construction*

Date: circa 1789

1 : a branch of mechanics that deals with forces and their relation primarily to the motion but sometimes also to the equilibrium of bodies

2 : a pattern or process of change, growth, or activity <population dynamics>

3 : variation and contrast in force or intensity (as in music)



Concept: What is dynamics?

In the field of **physics** the study of the causes of motion and changes in motion is **dynamics**. In other words the study of **forces** and why objects are in **motion**. *Dynamics* includes the study of the effect of **torques** on motion. These are in contrast to **Kinematics**, the branch of **classical mechanics** that describes the motion of objects without consideration of the causes leading to the motion.

Generally speaking, researchers involved in dynamics study how a physical system might develop or alter over time and study the causes of those changes. In addition, **Isaac Newton** established the undergirding **physical laws** which govern dynamics in physics. By studying his system of mechanics, dynamics can be understood. In particular **dynamics is mostly related to Newton's second law of motion.**

Concept: What is dynamics?

Dynamics can be subdivided into **kinematics**, which describes motion, without regard to its causes, in terms of position, velocity, and acceleration; and **kinetics**, which is concerned with the effect of forces and torques on the motion of bodies having mass. The foundations of **dynamics** were laid at the end of the 16th century by **Galileo** Galilei who, by experimenting with a smooth ball rolling down an **inclined plane**, derived the law of motion for falling bodies; he was also the first to recognize that force is the cause of changes in the velocity of a body, a fact formulated by **Isaac Newton** in the 17th century in his second law of motion. This law states that the force acting on a body is equal to the rate of change of the body's momentum.

Concept: What is dynamics?

Chapters 1, 2, 6



Chapters 3, 5, 7, 8



Relationship among ***position***, ***velocity***, and ***acceleration***

Relationship among ***forces*** and ***acceleration***

Calculation: How do we use dynamics?

Newton's 2nd Law of Motion

The **acceleration** of a particle is proportional to the resultant **force** acting on it and is in the direction of this force.

Force. A push or pull exerted on a body, characterized by:

- magnitude
- direction
- point of application

Mass. Measure of the resistance of a body to linear acceleration.

$$\mathbf{F} = m \mathbf{a}$$

Acceleration. Velocity rate of change with respect to time



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For Next Time...

- Read Chapter 1
- Begin Homework #1 due next week (8/29)
- Read Chapter 2, Sections 2.1 and 2.2