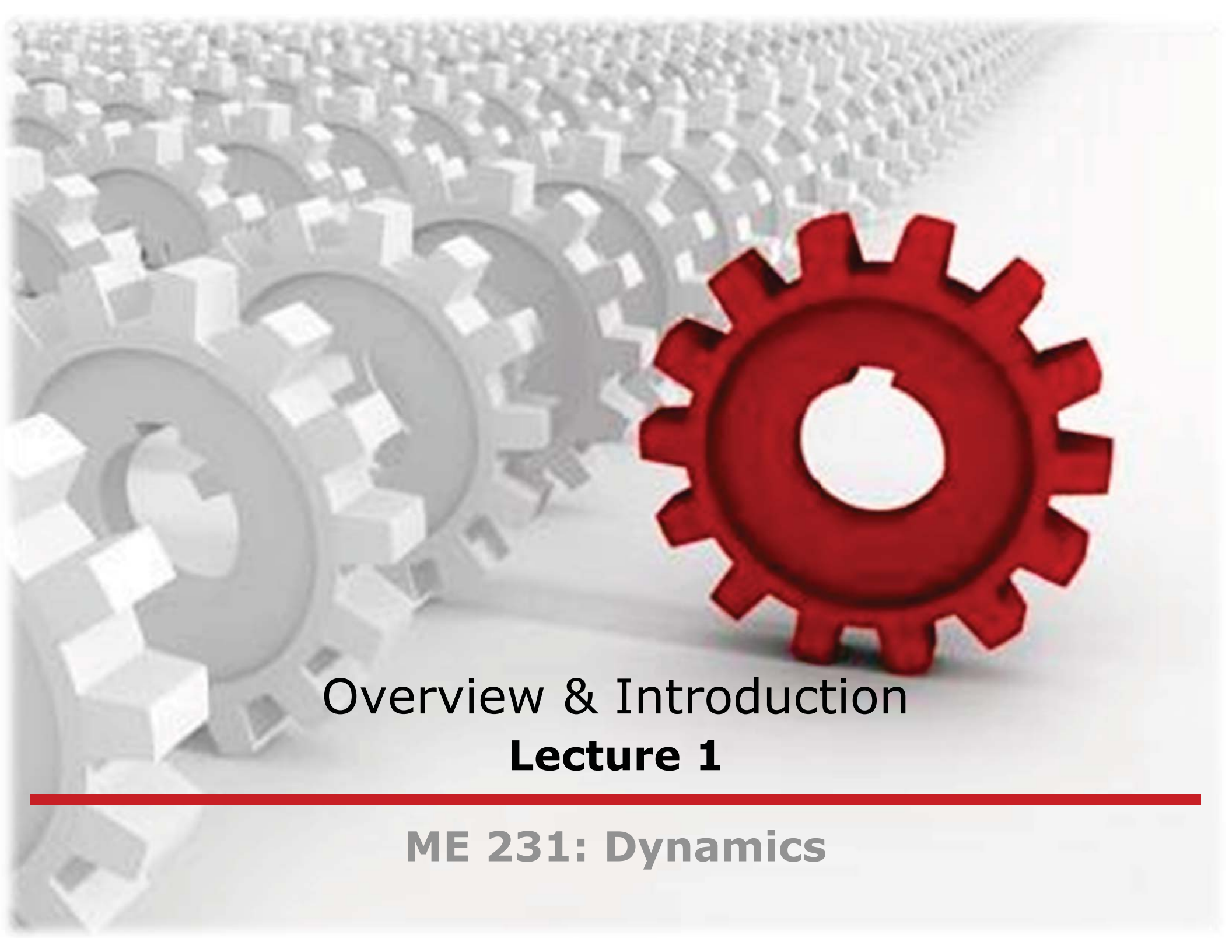


Overview & Introduction

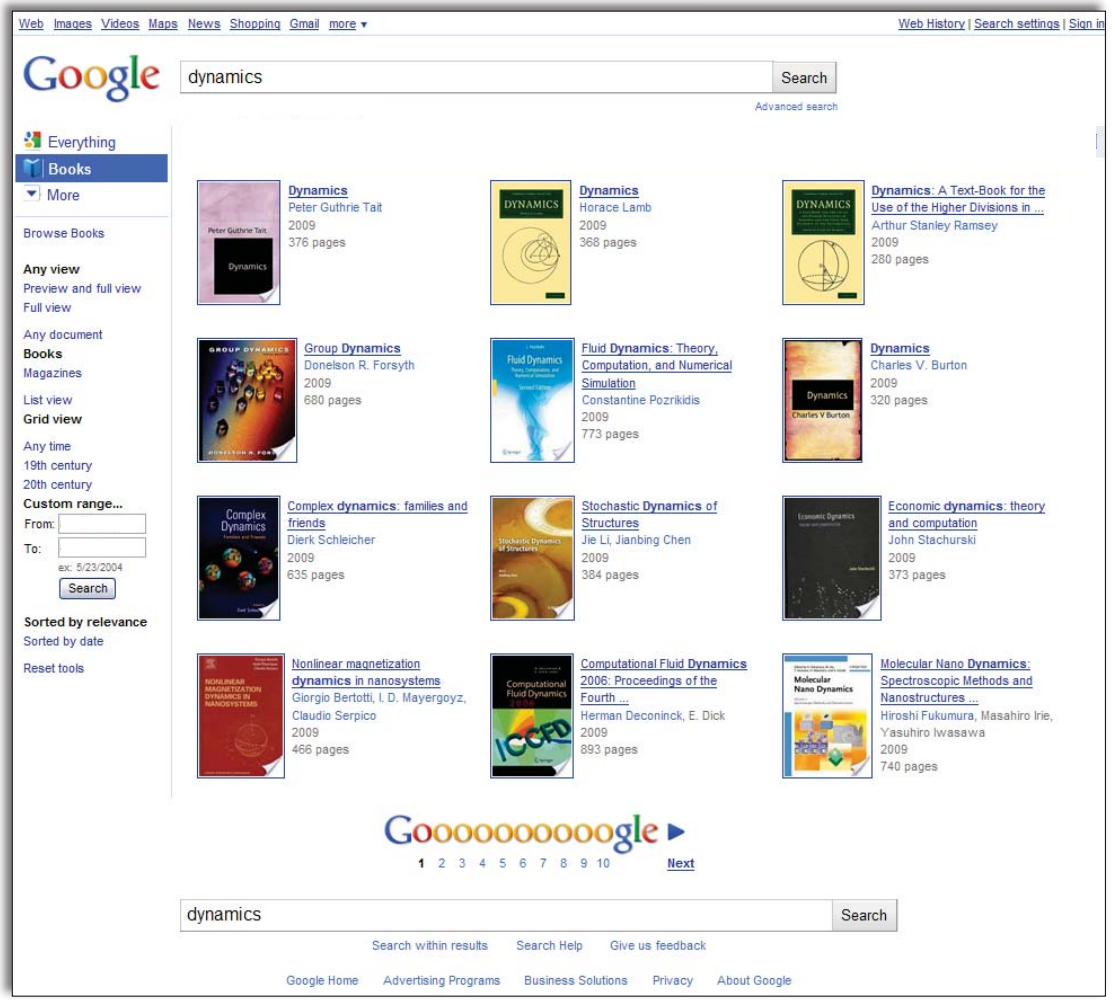
Lecture 1

ME 231: Dynamics

Question of the Day

What is dynamics & why is it important?

About $2x10^6$ results on Google books from the past two years alone



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

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

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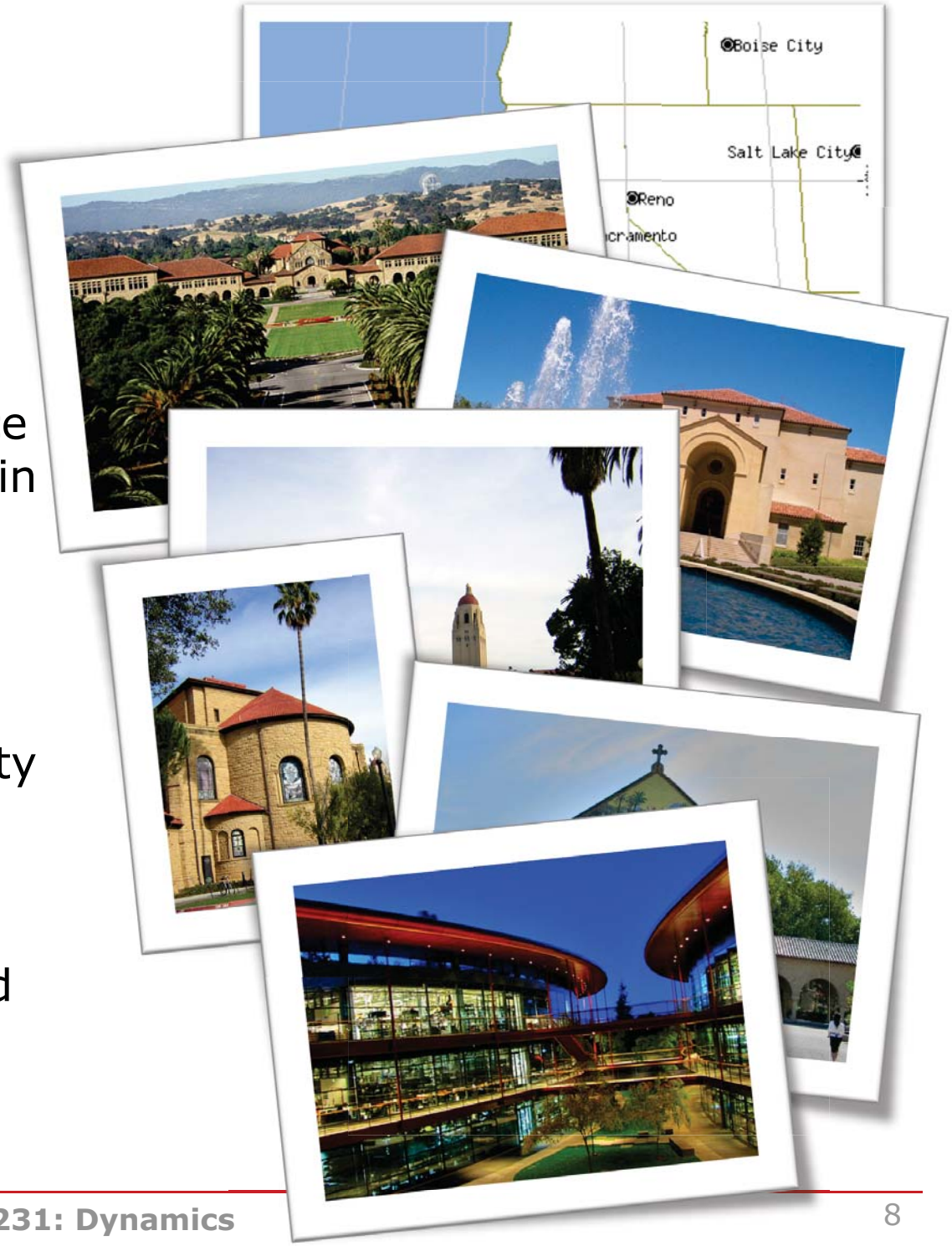
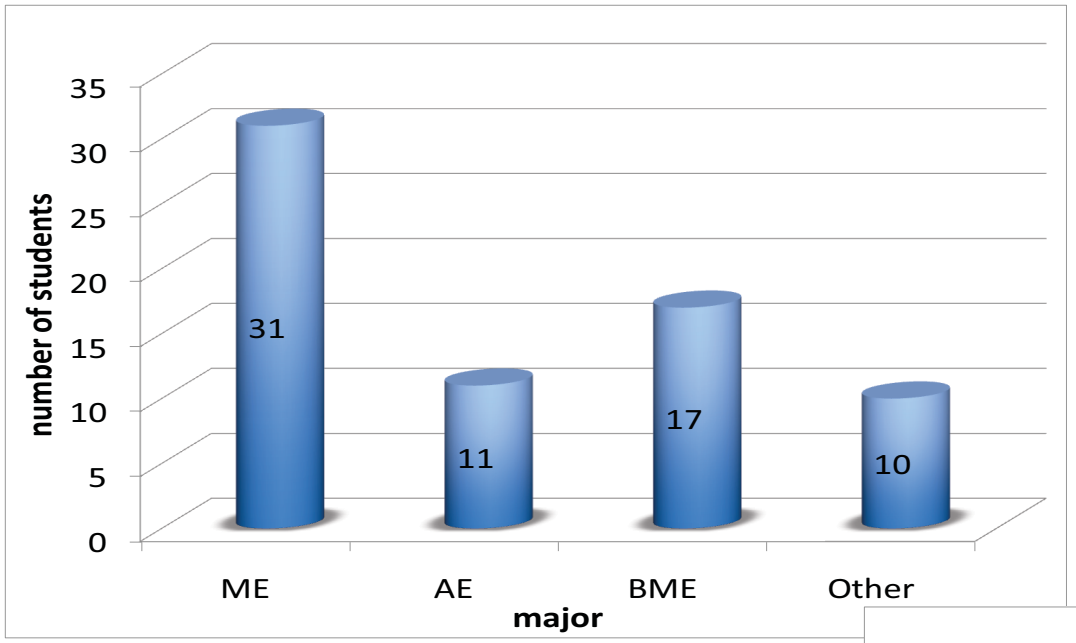
- Ph.D. in Mechanical Engineering from University of Florida in 2006
- Postdoc & Engineering Research Associate in Bioengineering at Stanford

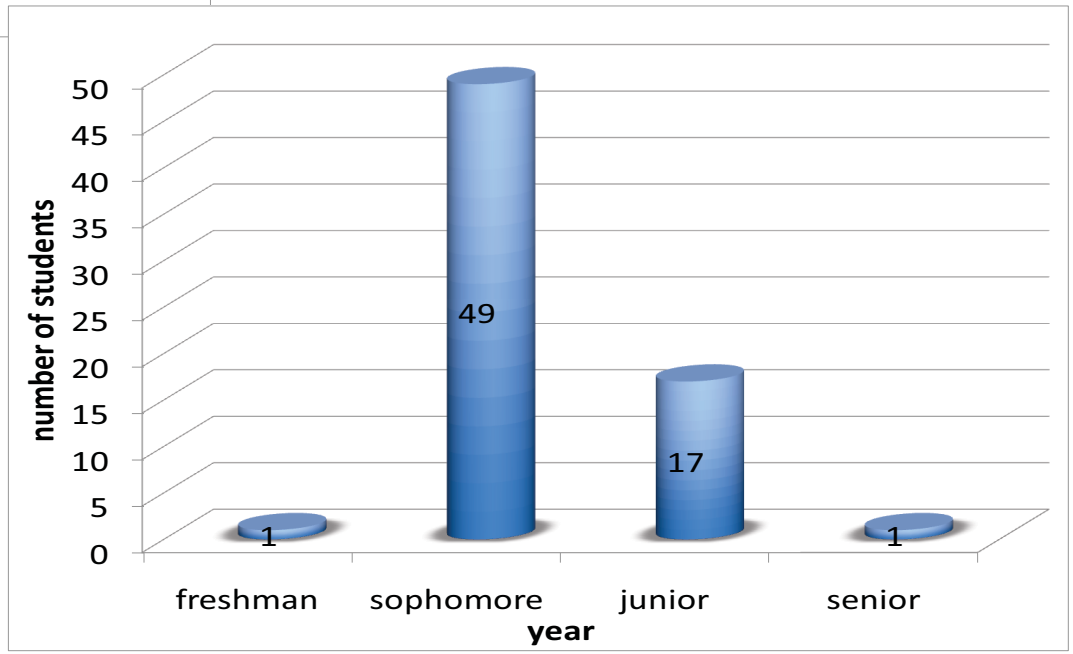


Who am I?

- 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?


number of students
35
30
25
20
15
10
5
0
31
11
17
10
ME
AE
BME
Other
major


number of students
50
45
40
35
30
25
20
15
10
5
0
1
49
17
1
freshman
sophomore
junior
senior
year

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?

Outline for Today

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What is in the syllabus and handouts?

THE UNIVERSITY of TENNESSEE KNOXVILLE
COLLEGE of ENGINEERING

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?

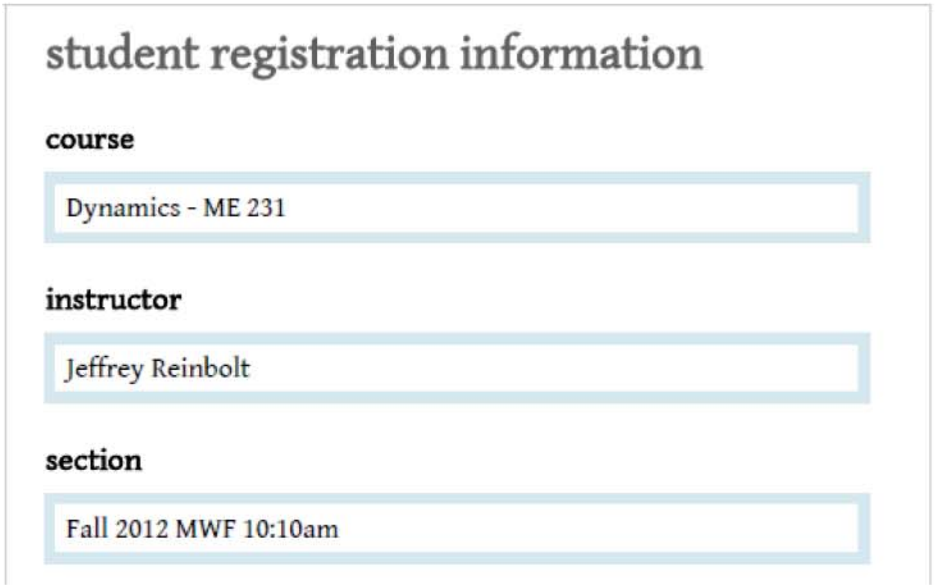
HOMEWORK ASSIGNMENTS
ME 231 ~ Dynamics

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:



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

Outline for Today

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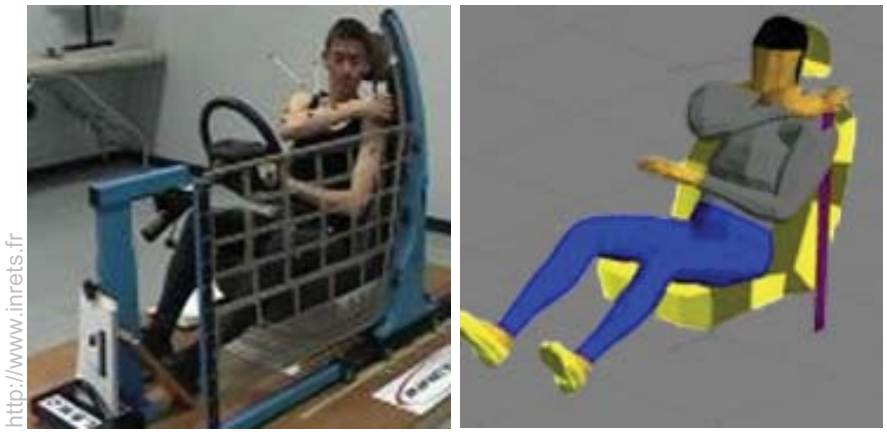
- Answer your questions!

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: \di-'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?

ENCYCLOPÆDIA Britannica eb.com

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

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

Chapters 3, 5, 7, 8

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