

# MAE143A Signals & Systems

<http://faemino.ucsd.edu/~soniamartinez/teaching>

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*Fundamentals of Signals and Systems* (Second Edition) 2007

by M.J. Roberts

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# MAE143A Signals & Systems

## Office Hours:

Robert Krohn: Mondays 14:30-15:30

Sonia Martinez: Thursdays 14:30-15:30

Where: EBU-II Office 305 (ALL of them)

Write to us to set an alternative meeting time  
if you cannot make it at any of the fixed office hours

# MAE 143A Assessment

**Regular lectures:** Tues - Thurs 12:30 - 13:50, CENTR 105

**Discussion Sections:**

Friday morning: 11:00-11:50, place TBA,

**Notice:** Homework will be due on Tuesdays in class (see calendar on syllabus/website)

**Grading:**  $\max\{F, M*30\% + F*45\% + H*25\%\}$

**One in-class midterm (M)**

Thurs May 7 (week 6)

**Final exam (F)**

Tues June 8 (week 11) 11:30 to 14:30

**Homework**

Due Tuesdays in class (see syllabus)

**Students with disabilities:** Please let me know ASAP

# MAE 143A Prerequisites

## Prerequisites and assumed knowledge

Math 20E Vector Calculus

Calculus, limits, continuity, differentiation, integration

Math 20F Linear Algebra

Vectors, matrices, eigenvalues, null spaces

Math 21D Differential Equations

Ordinary differential equations, Laplace transforms

Complex analysis, Mae 105

Basics on Fourier transform

Let's get started...

# Introduction

“Signal & Systems” view of the world

**Signals** - Any function that carries information

human voice, Morse code, electricity consumed, gas prices

# Introduction

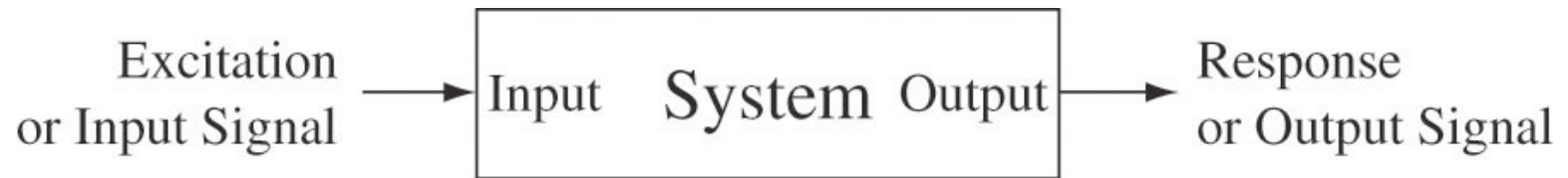
## “Signal & Systems” view of the world

**Signals** - Any function that carries information

human voice, Morse code, electricity consumed, gas prices

**Systems** - Operate on OR “filter” signals

human ear, telegraph, electric grid, economic system



(Two-port representation of a system)

# Introduction

## Examples

System	Input signal	Output signal
Car	motor force	displacement
Thermostat	temperature	air cond. Regulation
Optics of eye	visual stimulus	retinal image
Cochlea	sound	cochlea microphonic
Telephone	human voice	audio signal
Digital camera	blurred image	focused image

Systems are natural “filters” on signals. They can:  
amplify signals, delay them, distort them, introduce noise ...

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Systems are natural “filters” on signals. They can:  
amplify signals, delay them, distort them, introduce noise ...

Is it possible to determine a system response to any signal?

# Introduction

## How to determine a system response to signals

(a) Describe system through basic principles and solve corresponding ODE

Use Newton's, Kirchoff, constitutive relations...

(b) Compile of all outputs to all inputs experimentally ??

When no principles are known, use experiment

# Introduction

## How to determine a system response to signals

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Luckily, (b) is feasible for some types of systems

LTI systems: 1) can be characterized experimentally  
2) its response to all signals  
can be known by finding the response to a special subset of signals

# Introduction

## Main Course Objective:

Fundamentals of systems/signals interaction

(this is what we call "system analysis")

## Specific Course Topics:

- (Analog) Signals and System properties
- Computation of special LTI system responses
- Signals/LTI Systems in the Frequency Domain
- Particular signal & system examples: filtering, audio effects, AM / FM radio
- Sampling of signals (digital signals, compression) and signal reconstruction