# BMEN6372 / SYSM6306 / MECH6314 ENGR SYSTEMS: Modeling & Simulation

### **Course Information**

Spring 2015

Class Meeting: Mondays and Wednesdays, 10:00 – 11:15 AM Starts: January 12, 2015 Ends: May 11, 2015 Location: ECSN 2.120

Instructor: Dr. Robert D. Gregg Office: ECSN 3.202 Phone: 972-883-4657 Email: rgregg@utdallas.edu Office Hours: Tuesdays, 9:00 – 10:00 AM or by appointment

Teaching Assistant: Ge Lv Office: ATC 1.901 Email: gxl131030@utdallas.edu Office Hours: Fridays, 2:00 – 3:00 PM

#### Course Pre-requisites, Co-requisites, and/or Other Restrictions

Calculus, Linear Algebra, Differential Equations, Basic Probability and Statistics, Familiarity with Matlab

#### **Course Description**

This course will present principles of computational modeling and simulation of systems. General topics covered include: parametric and non-parametric modeling; system simulation; parameter estimation, linear regression and least squares; model structure and model validation through simulation; and, numerical issues in systems theory. Techniques covered include methods from numerical linear algebra, nonlinear programming and Monte Carlo simulation, with applications to general engineering systems. Modeling and simulation software is utilized.

#### **Student Learning Objectives/Outcomes**

Upon successful completion of this course, students will:

- 1. Be able to model deterministic systems and differentiate between nonlinear and linear models.
- 2. Be able to numerically simulate ordinary differential equations and deterministic systems.
- 3. Be able to model and simulate stochastic and discrete event systems.
- 4. Be able to estimate and validate a model based upon input and output data.

#### **Reference Material (not required)**

Textbooks in order of importance:

- 1. Introduction to Dynamic Systems: Theory, Models, and Applications. D. G. Luenberger, 1979.
- 2. Numerical Analysis, R. L. Burden and J. D. Faires, 1993.
- 3. Modeling and Simulation of Systems Using Matlab and Simulink., D. K. Chaturvedi, 2010.

#### **Required Software**

MathWorks MATLAB Access/installation: <u>http://www.utdallas.edu/ir/howto/matlab/</u>

#### Exams and Grading Policy

There will be homework assignments involving worked problems and computer simulations, a midterm exam, and a final exam. Grades will be determined based on the following formula:

Homework 25% Midterm 35% Final 40%

#### **Topical Outline (subject to change)**

The following topics will be applied to examples in biomechanics and robotics:

- 1. Deterministic Systems
  - Difference and Differential Equations
  - Solution of Linear Difference and Differential Equations
  - Numerical Simulation Methods for ODEs
  - Stability and Sensitivity Analysis
  - Hybrid Dynamical Systems
- 2. System Identification
  - Parameter Fitting
  - Linear Regression
  - Least Squares Method
  - Nonlinear Optimization Methods
- 3. Stochastic Systems
  - Probability Distributions
  - Generating Random Variables
  - Monte Carlo Simulation
  - Markov Processes and Discrete Event Systems

#### **Course & Instructor Policies**

No late homework or make-up exams will be accepted. Class attendance is expected—students are responsible for all material presented in class, regardless of whether they were in attendance. Exams will be held during class time.

#### **Technical Support**

If you experience any problems with your UTD account you may send an email to: <u>assist@utdallas.edu</u> or call the UTD Computer Helpdesk at 972-883-2911.

#### **Policies and Procedures for Students**

**Email Use:** Emails to Prof. Gregg should be sent from the student's official UT Dallas email account. Per FERPA policy, grades *cannot* be discussed via email.

Cell Phone Use: Cell phone use (e.g., texting) is disruptive to class and will not be tolerated.

**Laptop Use:** Laptop use is not permitted during lecture. Touchscreen devices will be allowed for note-taking unless such use becomes disruptive to the class.

**Scholastic Dishonesty:** The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work.

Any student who commits an act of scholastic dishonesty is subject to discipline. Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, submitting for credit any work or materials that are attributable in whole or in part to another person, taking an examination for another person, or any act designed to give unfair advantage to a student or the attempt to commit such acts.

**Student Conduct and Discipline:** The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UT Dallas printed publication, *A to Z Guide*, which is available to all registered students each academic year.

The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the *Rules and Regulations, Series 50000*, Board of Regents, The University of Texas System, and in *Title V, Rules on Student Services and Activities* of the university's *Handbook of Operating Procedures*. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391) and online at <a href="http://www.utdallas.edu/judicialaffairs/UTDJudicialAffairs-HOPV.html">http://www.utdallas.edu/judicialaffairs/UTDJudicialAffairs-HOPV.html</a>.

## NOTE: Prof. Gregg will refer *all* cases of academic dishonesty to the Dean of Students for adjudication.

**University Policies and Procedures:** The University of Texas at Dallas provides a number of policies and procedures designed to provide students with a safe and supportive learning environment. Brief summaries of the policies and procedures are provided for you at <a href="http://go.utdallas.edu/syllabus-policies">http://go.utdallas.edu/syllabus-policies</a> and include information about technical support, field trip policies, off-campus activities, student conduct and discipline, academic integrity, copyright infringement, email use, withdrawal from class, student grievance procedures, incomplete grades, access to Disability Services, and religious holy days. You may also seek further information at these websites:

http://www.utdallas.edu/BusinessAffairs/Travel\_Risk\_Activities.htm http://www.utdallas.edu/judicialaffairs/UTDJudicialAffairs-HOPV.html http://www.utsystem.edu/ogc/intellectualproperty/copypol2.htm http://www.utdallas.edu/disability/documentation/index.html

These descriptions and timelines are subject to change at the discretion of the Professor.