

THE UNIVERSITY OF TEXAS-PAN AMERICAN  
Department of Mathematics

Math 6387.01: Math. Modeling Summer II 2012

MAGC 1.206 MTWRF 16:05-17:35

**Contact information**

**Instructor:** Dr. Eleftherios Gkioulekas, Department of Mathematics

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**Office hours:** TR 14:00-15:00

**Office location:** MAGC 3.214

**Course information**

**Prerequisites:** Consent of instructor.

**Corequisites:** None.

**Course Description:** This course presents the theory and application of mathematical modeling. Topics will be selected from dynamic models, stable and unstable motion, stability of linear and nonlinear systems, Liapunov functions, feedback, growth and decay, the logistic model, population models, cycles, bifurcation, catastrophe, biological and biomedical models, chaos, strange attractors, deterministic and random behavior.

**References**

- (1) S.H. Strogatz (1994): "Nonlinear dynamics and chaos", Addison-Wesley [course textbook]
- (2) E. Gkioulekas (2010): "Mathenatical Modeling", online lecture notes
- (3) B. Deconinck (2009): "Dynamical,systems", online lecture notes
- (4) S. Wiggins (2003): "Introduction to Applied Nonlinear Dynamical Systems and Chaos", 2nd edition, Springer-Verlag

See course website for hyperlinks.

**Outline of Topics**

- Introduction to autonomous dynamical systems
- 1D autonomous systems
- Linear autonomous systems
- Nonlinear autonomous systems
- Limit cycles
- Center manifold reduction
- Miscellaneous Topics

**Grading Policies**

- **Grading:** There will be 4 major exams, and a comprehensive final exam. The time and location of exams will be announced in class. Exams count for 75% (with lowest exam score dropped) and final exam for 25%. Attendance will be taken. For each absence I will deduct 1% from your total grade, starting from a 3% attendance credit. Combined, you get a numerical grade on a scale 0-20. Each exam question is graded on a 0-4 scale with 4 = A, 3 = B, 2 = C, 1 = D, 0 = F. Combining all exams, as explained above, gives a weighted average score on a 0-20 scale. This

score is then mapped to a letter grade as follows: A: 16-20; B: 12-16; C:10-12; D; 7-10; F: 0-7. If there is a downcurve, I will announce it in class and on the course website.

- **Lectures:** Students are expected to attend each lecture. You're expected to know everything I cover in lecture, regardless of whether or not it is covered properly in your textbook. If you miss any meeting, it is your responsibility to get class notes from another student.
- **Homework:** Homework will be assigned, but will not be collected or graded. Nevertheless, it is crucial to do the homework as part of your preparation for the exams. To keep up, I recommend that **after every lecture you should solve the homework problems corresponding to the material covered on that day's lecture. Thus you need to work on a continuous basis!**
- **Make-ups:** There are no make-up exams. In the case of **excused** absences the final exam will be used as a make-up exam. **Each student MUST take the final exam at the scheduled date and time.** There will be no make-ups for the final exam, after the official final exam date!
- **Regrading policy:** If you believe that a mistake in grading has been made you may request that your paper be regraded. Such request must be submitted **in writing** within one week from the day the graded test has been returned in class, and must be accompanied by the original (unaltered) paper. If you make any changes to the paper your request will be denied. Please note that if you request regrading, all problems are subject to review. Thus, your overall grade may be increased or decreased.

### Other Policies

- **Course web page:** A course web page will be used to distribute the syllabus, assigned homework, solutions to exams, a copy of my lecture notes, and any other relevant material. A link to that page will be available from my main page at <http://faculty.utpa.edu/gkioulekase/>
- **Extra Help:** You can get additional help during my office hours or from the following locations:
  - (1) The *LSAMP Math Lab* is located in room MAGC 3.510 of the Math building. Tutoring hours are Monday - Friday: 8:00 am - 5:00pm All undergraduate math courses are tutored.
  - (2) *The Math Learning Center* is located in the LEAC building (the old Math building), room 114. Tutoring hours are: Monday-Thursday 8:30 am - 6:00 pm and Friday 8:30 am - 4:00 pm. Courses tutored are: MATH 1300; MATH 1334; MATH 1340; MATH 1341; MATH 1342; MATH 1450; MATH 1460; MATH 1470.
- **Departmental Calculator Policy:** A calculator capable of performing basic scientific computations (arithmetic, trigonometric functions, logarithmic and exponential functions) is required for this course. Graphing calculators, calculators that can store formulas or strings, or calculators capable of performing symbolic calculations will not be allowed in quizzes/tests/exams. Electronic equipments such as pocket organizers, handheld or laptop computers, electronic writing pads or pen-input devices, and cell phones will not be permitted during quizzes and exams. Graphing calculators will be permitted for solving homework problems.
- **More about Calculator Usage:** The problems you will encounter in my exams will not require a calculator, and you are better served in the long-term by minimizing your dependence on calculators. Don't use the calculator to approximate roots, exponentials, logarithms, etc. Mathematical problems require **exact** answers. Approximations are reasonable **only** on word problems where the numbers given may be approximate themselves, and thus the best answer that can be deduced is approximate (e.g. the 800 pound gorilla may in fact weigh 799.97356 pounds and not 800 pounds exactly, but the diagonal of a square with side 1 is *exactly*  $\sqrt{2}$ , not 1.41).
- **Classroom Conduct:** Common courtesy requires that students arrive in class on time, and stay the entire class period. Turn your cellphones and pagers off. You are required to treat your

classmate and instructor with respect and courtesy. Use of any electronic devices, except for calculators, is not allowed in class, and I reserve the option to remove you from the classroom without warning for any behaviour that I deem as disrespectful or disruptive. You agree to indemnify and hold harmless the professor with respect to all actions undertaken by the professor to enforce classroom conduct or to properly proctor exams. For example, I may have to close your laptop, turn off your cell phone, temporarily seize a calculator that violates policy during exams, or move a notebook or text away from your desk during a closed notes closed book exam. Taking my course implies your consent to this policy.

- **Revisions:** This syllabus may be revised at any time. If it is revised, this will be announced in class, and logged on the course web site, where the revised syllabus will be made available. The syllabus posted on the professor's course web site is the only copy guaranteed to incorporate all revisions that may be made under this policy and will thus supersede any other versions posted on other university websites.
- **Email Policy:** Only email sent to my private email account is accessible to me via my Android device, due to the requirement that I permit UTPA systems to be able to remotely wipe my Android device in order to access UTPA email with it. Consequently, email sent to my UTPA email address requires a longer time for me to respond.
- **Mandatory Course Evaluations:** Students are required to complete an ONLINE evaluation of this course, accessed through ASSIST via your UTPA account (<https://my.utpa.edu/>); you will be contacted through email and ASSIST on August 6 with further instructions. The evaluation window closes at 11:59pm on August 13, the last day of classes. Students who complete their evaluations by August 13th will have priority access to their grades.
- **Disability Access Statement:** Students with disabilities are encouraged to contact the Disability Services Office for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Texas-Pan American to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Disability Services office (DS), University Center # UC 108 (on the first floor), 665-7005, [disabilityservices@utpa.edu](mailto:disabilityservices@utpa.edu). The Director of Disabilities is Christine Stuart-Carruthers, 665-5375, [carruthers@utpa.edu](mailto:carruthers@utpa.edu).
- **Academic integrity:** Student Code of Conduct: Each and every student registered for the section are expected and strictly required to comply at least with the following student conduct code and to observe standards of conduct appropriate for an academic institutions. The following practices are considered unacceptable conduct.
  - (1) *Cheating:* Cheating involves: (1) copying from the test paper of another student, engaging in written, oral or any other means of communication with another during a test, or giving aid to or seeking aid from another student during a test; (2) possession and/or use during a test of materials which are not authorized by the person giving the test, such as class notes, books, or specially designed "crib notes"; (3) using, obtaining, or attempting to obtain by any means the whole or any part of an unadministered test, test key, homework solution, or computer program; (4) collaborating with or seeking aid from another student for an assignment without authority; (5) taking an examination for another person, or permitting another person to take an examination of one's self; and (6) falsifying research data, laboratory reports, and/or other academic work offered for credit.
  - (2) *Plagiarism:* Any attempt by a student to represent the work of another as his or her own is considered as plagiarism. Of course, to prepare the course materials students are not only

encouraged to discuss with the concerned instructor, they are allowed to discuss with fellow students, consult any books, journals, articles, internet or any other external resources; but work or answers presented by the students in the quiz, test or exam must be in their own style and written in their own words of understanding. In the academic world, plagiarism by students is a very serious offence that can result in severe punishments such as failing grade on the particular assignment or for the course.

Plagiarism and Cheating of any kind on an examination, quiz, or assignment will result at least in an "F" for that assignment (and may, depending on the severity of the case, at the instructor's discretion, lead to an "F" for the entire course) and may be subject to appropriate referral to the University Administration.

### Student Learning Outcomes

After completing this course students will be able to

- (1) Solve problems involving optimization models, dynamic models, growth and decay, the logistic model and population models.
- (2) Understand concepts of stable and unstable motion, stability of linear and nonlinear systems, Liapunov theory.
- (3) Identify bifurcation and catastrophe phenomena.
- (4) Recognize dynamics and bifurcation in biological and biomedical models.
- (5) Distinguish "deterministic" and "random" behavior.
- (6) Implement a variety of problem-solving strategies, and evaluate and transform mathematical expressions.
- (7) Find and utilize mathematical models which reasonably approximate the behavior of real world problems.