Numerical Linear Algebra – Math5333.001
Department of Mathematics and Statistics
Spring 2015

A. COURSE INFORMATION
Course number/section: Math5333.001
Class meeting time: MWF 9:00 to 9:50
Class location: OCNR 130
Course Website: None

B. INSTRUCTOR INFORMATION
Instructor: Dr. Pablo Tarazaga
Office location: CI 316
Office hours: TR 10:00 to 12:00 and M 10:00 to 11:00
Telephone: (361) 825-3187
E-mail: pablo.tarazaga@tamucc.edu
Appointments: By e-mail.

C. COURSE DESCRIPTION
In this course we will cover numerical solutions of linear systems of equations, computing least square solutions, computing eigenvalues and eigenvectors, computing singular value decomposition. Factorizations. Iterative methods for linear systems of equations. Error estimation and algorithms. We will use MATLAB as the computing environment.

D. PREREQUISITES AND COREQUISITES
Prerequisites
Math 311 (Linear Algebra)
Basic Knowledge of Matlab Programming

Corequisites
N/A

E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES
Textbook

Supplies
None
F. STUDENT LEARNING OUTCOMES AND ASSESSMENT

Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

At the end of the course, a student will be able to

1. Use basic norms for vectors and matrices. Identify and use basic matrix classes. Identify and use transformation that produce zeros in matrices, especially Householder and Givens transformations.

2. Compute solutions of linear system of equations and least squares solutions. Write codes for these problems and perform error estimation.

3. Compute eigenvalues and eigenvectors of a matrix; write some codes for this problem.

4. Compute singular values and singular vectors of a matrix; write some codes for this problem. Establish the relation with eigenvalues and eigenvectors

5. Use iterative methods to find solutions of linear systems of equations.

G. INSTRUCTIONAL METHODS AND ACTIVITIES

The class uses lecture format encouraging student participation and discussion.

H. MAJOR COURSE REQUIREMENTS AND GRADING

- All the work done in the class will be part of your final grade (tests and final). I will evaluate very carefully the learning objectives.
- The table below shows the weight of each of the items considered to determine your grade.
- Assignments will be given with each section of the book that we cover during the course, but they will not be collected.
- Quizzes will be about the material we are covering and assignments will be on some problems and codes for the main algorithms.
- The midterm and the final will contain problems, basic proofs and writing codes.
- Final exam will be comprehensive.
<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>% of FINAL GRADE</th>
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</thead>
<tbody>
<tr>
<td>Quizzes and assignments</td>
<td>35%</td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>30%</td>
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<tr>
<td>Final Exam</td>
<td>35%</td>
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I. **COURSE CONTENT/SCHEDULE**

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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<tbody>
<tr>
<td>8/24</td>
<td>Introduction to norms.</td>
</tr>
<tr>
<td>8/41</td>
<td>Basics in Floating points arithmetic.</td>
</tr>
<tr>
<td>9/7</td>
<td>Transformation in numerical linear algebra.</td>
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<tr>
<td>9/14</td>
<td>Solving linear systems of equations.</td>
</tr>
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<td>9/21</td>
<td>Gauss and the LU factorization.</td>
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<tr>
<td>9/28</td>
<td>Perturbations and condition number.</td>
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<tr>
<td>10/5</td>
<td>Least squared solutions geometric interpretation.</td>
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<tr>
<td>10/12</td>
<td>Normal equations, QR factorization.</td>
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<tr>
<td>10/18</td>
<td>Eigenvalues and Eigenvectors, theorems on localization.</td>
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<tr>
<td>10/25</td>
<td>Computing selected eigenvalues.</td>
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<td>11/2</td>
<td>Implicit QR iteration.</td>
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<tr>
<td>11/9</td>
<td>Singular value decomposition.</td>
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<tr>
<td>11/16</td>
<td>Computing singular values and singular vectors.</td>
</tr>
<tr>
<td>11/23</td>
<td>Iterative method for linear systems: structure and convergence.</td>
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<tr>
<td>11/30</td>
<td>Classis and new methods</td>
</tr>
<tr>
<td>12/7</td>
<td>Final Exam (8:00 – 10:30)</td>
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Note: Changes in this course schedule may be necessary and will be announced to the class by the Instructor. The assignments and exams shown are directly related to the Student Learning Outcomes described in Section F.

J. **COURSE POLICIES**

- **Attendance**
  It will not be part of your grade, but it is required. Exceptions are sickness and emergencies.

- **Preparation for class**
  I do expect that you come to each class ready to learn and to participate. Also you have to be prepared to do any required work. You are expected to devote for each hour of class a
minimum of two or three hours outside the class working in the subject (some people need more time than others).

- **Missed Exam**
  If you are missing a test, you have to tell me beforehand by any means, examples: e-mail or phone. There is not date change for any exam including the Final Exam.

- **Grades**
  After you receive your grades you have up to a week to dispute it. I am the person you can dispute your grade with.

- **Class withdraw**
  If at any point during the course you are considering to drop the class, talk to me before you do it. I am here to help you in your learning experience and to help you to succeed in your college career.

- **Food in Class**
  Food is *not allowed* in the classroom.

- **Cell Phone Use**
  PLEASE TURN YOUR CELLULAR PHONES OFF. PLACE THEM IN YOUR BAG OR POCKET DURING THE CLASS. DO NOT DISTURB THE CLASS WITH THEM.

K. **COLLEGE AND UNIVERSITY POLICIES**

- **Academic Integrity (University)**
  University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

- **Classroom/Professional Behavior**
  Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms,
labs, discussion groups, field trips, etc.

- **Statement of Civility**
  Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

- **Deadline for Dropping a Course with a Grade of W (University)**
  The grade of W will be assigned to any student officially dropping a course. Please consult with the instructor before you decide to drop to be sure it is the best thing to do. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Should dropping the course be the best course of action, visit the Office of the University Registrar for the Course Drop Form that must be submitted. No student is eligible to receive a W without completing the official drop process by this deadline. Please consult the Academic Calendar (http://www.tamucc.edu/academics/calendar/) for the last day to drop a course.

- **Grade Appeals (College of Science and Engineering)**
  As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at http://www.tamucc.edu/provost/university_rules/index.html, and the College of Science and Engineering Grade Appeals webpage at http://sci.tamucc.edu/students/GradeAppeal.html. For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the College of Science and Engineering Dean, or the Office of the Provost.

- **Disability Services**
  The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or
visit Disability Services in Corpus Christi Hall 116.

If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

http://disabilityservices.tamucc.edu/

- **Statement of Academic Continuity**
  In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

L. **OTHER INFORMATION**

- **Academic Advising**
  The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The College’s Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.

**GENERAL DISCLAIMER**

I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.