Scientific Computing, MAT 5712, Fall 2017

Time and Place: TR 12:30-1:50, CB1 218

Instructor: Dr. Teng Zhang
Office: MAP 202G *E-mail:* teng.zhang@ucf.edu
Office Hours: MR 4:00-5:30 or by appointment

Textbooks: *Numerical Analysis: Mathematics of Scientific Computing* (3rd edition) by D. Kincaid and W. Cheney (Required Text)
Scientific Computing with MATLAB and Octave (4th edition) by A. Quarteroni, F. Saleri, and P. Gervasio (Suggested Text)

Prerequisites: MAC 2313 (Calculus III), MAP 2302 (Differential Equations), MAS 3105 (Matrix & Linear Algebra) or their equivalents. Proficiency with Taylor series and ability to prove/apply theorems are *essential.* Programming experience is helpful but not necessary.

Course Goals and Objectives: The aim of this course is to teach students how to derive, analyze and implement numerical methods for solving mathematical problems. To achieve these aims students will learn how to write program code, using modern mathematical software. This is an introductory course and will cover the 4 basic topics of floating point arithmetic, roots of nonlinear equations, interpolation, and numerical integration, which are covered in Chapters 1, 2, 3, 6, and 7 of the Kincaid and Cheney textbook, and Chapters 1-4 of the Quarteroni, Saleri, and Gervasio textbook.

On-line Course Materials: All course content is available through WebCourses on MyUCF. All lectures will be recorded as video stream and made available through the Panopto powerlink. Lecture notes, assignments, programs (written in Matlab) for computer projects, announcements, changes to the syllabus, links to Matlab tutorials, and other materials will be posted on this course web page. *Students will be held responsible for keeping informed.*

Software: The Department of Mathematics has Matlab on computers that are available to students. The computer store has the student version of Matlab for about $100. An alternative to Matlab is Octave, which is available on-line for free. Octave is suitable for the requirements of this class, and the language is *nearly* identical to Matlab.

Assignments and Computer Pojects: Weekly assignments, generally from the textbook by Kincaid and Cheney, will include both theoretical and computational problems. There will be two computer projects due on October 9 and November 27. Assignments and Computer Projects may be submitted to the instructor in hard copy or on-line through WebCourses. Details of assignments are posted on the webcourse web page. Any work submitted on-line must be a single file in pdf format, and the file name must include the students last name and the name of the assignment.

Exams: There will be one in-class midterm exam on Tuesday October 17, and an in-class final exam on December 5, over all material covered in class since the midterm. These exams are closed book and closed notes, but students may use non-programmable, single line display, scientific calculators. Students are required to speak to me in advance if it is known that you will be unable to attend an exam. Make-up exams are only allowed if your absence is justified by substantial documentation and only in the cases of illness, family emergencies, religious holidays, and university related work.

Grade Composition: Assignments 20%, Computer Projects 30%, Exams 50% (midterm exam 20%, final exam 30%)

Grade Assessment: A correct solution in an assignment or an exam consists, not only of a correct answer, but also of reasoning or calculation, which is correct and leads up to the final answer. High marks will not be given for work that is poorly communicated.

Grade Scale: A $(100, 85]$; B $(84, 70]$; C $(69, 60]$; D $(59, 50]$; F $(50, 0)$

Testing for On-Line Students: Students that are unable to attend the midterm and final exams are required to arrange a location and proctor for the exam. Any fees for this service are the students responsibility. Acceptable locations include UCF regional campuses, local community colleges or high schools, and public libraries. No later than two weeks before each exam, students must provide:

- Name and location of the facility for the proctored exam.
- Name and affiliation of the proctor.
- E-mail and telephone number of the proctor.

The exam must be taken on the same day and time as the in-class exam.

Technical Support: If you experience difficulty with any on-line aspect of the course, please contact online support at UCF (online.ucf.edu/support/). Please leave detailed messages about your problem, including course prefix and section number, as well as the date the lecture was recorded, if pertinent.

Complaints: Any complaints should first be brought to my attention. If, having done this, the issue remains unresolved, then you may make an appointment to speak with the Chair of the Department of Mathematics, or contact the Department Secretary in MSB 207.

Students with Disabilities: I would like to hear from anyone who has a disability which may require seating modifications or testing accommodations or accommodations of other class requirements, so that appropriate arrangements may be made. Please contact me during my office hours, and contact Student Disability Services, Ferrell Commons 132.

Deadline for Withdrawal: October 30, 11:59pm

Tentative Course Schedule
Topics Covered with Sections Numbers from the Textbook by Kincaid and Cheney

Week 1: Taylor's Theorem, Order of Convergence, Nested Multiplication (1.1, 1.2)

Week 2: Machine Arithmetic (2.1)

Week 3: Error, Conditioning, Stability (2.2, 2.3)

Week 4: Bisection and Newton Methods (3.1, 3.2)

Week 5: Variations on Newton's Method, Fixed Point Iterations (3.3, 3.4)

Week 6: High Multiplicity Roots, Roots of polynomials (3.5)

Week 7: Homotopy and Continuation (3.6); Stopping Criteria, Aitken Extrapolation

Week 8-9: Polynomial Interpolation, Error (6.1), Review and Midterm Exam

Week 10: Chebyshev and Hermite Interpolation (6.2, 6.3)

Week 11: Splines (6.4, 6.5)

Week 12: Least Squares (6.8), Higher Dimensions (6.10), Numerical Differentiation (7.1)

Week 13: Iterpolatory Quadratures and Error (7.2)

Week 14: Hermite and Gaussian Quadrature (7.3)

Week 15: Richardson Extrapolation, Romberg Integration (7.4); Adaptive Quadrature (7.5)