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Computer Science & Engineering Syllabi   College of Engineering & Computer Science

Spring 2013

CS/MTH 3260/5260: Numerical Methods for Digital Computers

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CS/MTH 3260/5260 Numerical Methods for Computational Science

Spring 2013 M W 6:10 – 7:30 p.m., Russ Center Room 346
Last Update: January 5, 2013

Description: Numerical methods for the sciences using modern programming languages. Solution of linear and nonlinear equations, symmetric matrix eigenvalue problems, interpolation, and least squares. Initial value and boundary value problems for representative systems governed by ordinary and partial differential equations are also solved numerically. Three hours lecture.

Prerequisites: (CS 1180 or CS 1160 or CEG 2170) and MTH 2350 or (MTH 2330 and MTH 2530). Course descriptions at: http://catalog.wright.edu/courses/

Instructor: Dr. Ronald F. Taylor, RC 340, 775-5122, ronald.taylor@wright.edu , Tuesday and Thursday 3 – 5 p.m.; other times by appointment.

Required Textbook: Numerical Methods, Fourth Edition, J. Douglas Faires and Richard L. Burden, Brooks/Cole, 2013, ISBN-13: 978-0-495-11476-5.

Reference Textbooks: Scientific Computing with Case Studies, Dianne P. O'Leary, SIAM, 2009.
Introduction to MATLAB for Engineers, 3rd Edition, William J. Palm III, McGraw-Hill, 2010.
Mastering MATLAB, Duane Hanselman and Bruce Littlefield, Prentice Hall, 2004 or 2011 edition.
C Programming – A Modern Approach, Second Edition, K. N. King, Norton & Co, 2008.

Pilot and Course Studio: We will be using Pilot for posting of grades and submittal of some assignments or portions of assignments. Students should familiarize themselves with accessing Pilot . Content will be in Course Studio and possibly moved to Pilot later in the semester. Students are responsible for accessing Course Studio for printing copies of resource materials as needed. Minimal handouts will be given in class.

Programming: MATLAB Student Edition http://www.mathworks.com/academia/student_version/ from MathWorks (about $100). Wright State University's College of Engineering and Computer Science provides a special licensing program for the MathWorks MATLAB software. More information at http://www.wright.edu/software/mathworks/ . Students may also use Octave which is free http://www.gnu.org/software/octave/download.html . When we refer to "MATLAB" students may also substitute "Octave". If you decide to use Octave instead of MATLAB, please inform the instructor. Writing and using numerical programs is an important part of this course. Programming assignments mostly will require MATLAB which is available on a number of Wright State systems. It is expected that students will spend a minimum of 2 hours per week working in a computer lab or equivalent environment enhancing their programming skills and completing programming assignments for this course. We may also use the C programming language for some class demonstrations. Some assignments may involve using or adapting some given C programs.

Computers and Computing Accounts: You must be able to access the Web and have a WSU Student Login to Wings, e-mail, Pilot, and Course Studio. Check your WSU e-mail on a regular basis for any course announcements from the instructor. Get familiar with the use of workstations in Russ to access MATLAB if you do not have it on your own PC. Needed computing topics be covered in class and web citations given as appropriate. Check the University computing information at http://www.wright.edu/cats/studentzone .

Grading Policy: Three exams and several quizzes – 75% . No comprehensive final during finals week. Homework/Project assignments – 25%. Quizzes may be in class or take-home: points included with total points on the exams. For example, three exams at 100 each points plus five 10 point quizzes means that 75% of the grade is based on a maximum of 350 points. Homework/Projects will be checked for organization, completeness, and accuracy. Quizzes may be given on the day of Homework/Project submittal. Students are expected to be able to answer questions regarding these submittals. Students will be allowed to use only their own Homework/Project submittal and a calculator during these types of quizzes. Points for all graded items will be given when each assignment is made. In general, about one week will be given to prepare larger assignments. Smaller homework problems/investigations may be due the next class period. Follow the "Homework Standards" posted online. Students registered at the graduate level (i.e. CS 5260 or MTH 5260) will be required to complete extra problems, programs and/or special projects as part of the Homework/Project component of this course.

Course Grade Based on Course Average:

A: 100-90, B: less than 90-80, C: less than 80-70, D: less than 70-60, F: less than 60-0.

Class Policies: No late or early exams unless verifiable emergency. <u>No make-up quizzes: some quizzes may be unannounced.</u> Attendance at lecture is not a component of your grade. However, students are expected to attend all lectures and to participate in class discussion. Attendance may be taken in the course to better get to know students. In cases of infrequent attendance, lower homework and exam grades will inevitably result since a significant portion of lecture material is not covered in the text. All Homework/Project assignments are due in class on the date and time specified. Grades on late assignments will be reduced by 10%. Submittals more than one day late will not be graded - "zero" grade assigned. Exceptions to the above policies may be made unusual circumstances when documentation is provided in writing -- otherwise expect strict enforcement of the policies. All work submitted must be your own unless group assignments are explicitly made by the instructor; sharing of program code or copying problem solutions/codes from any source will result in at least a homework grade of "zero" for all involved and possibly a grade of "F" for the course. University procedures for plagiarism will be strictly followed. Sharing ideas and general mathematical and computer skills with others outside of class is encouraged. Students are expected to read, understand and follow the University Academic Integrity Policy at: http://www.wright.edu/students/judicial/integrity.html .

Supplemental Class Information and Homework Standards: A document: "Supplemental Information" is given online which clarifies and details how the above class and grading policies are to be implemented. Also carefully study and follow the "Homework Standards" document online. Students are responsible for understanding these documents referring to them during the quarter as needed. Please ask for clarification if you have questions on either of these two important documents.

Course Outline/Topics/Schedule: Topics may vary. **Exams dates and times** are firm. Numbers indicate text readings: Chapter.Section.

- **Part I – Introduction, Roots and Interpolation: 5 weeks**

  - Mathematical Preliminaries, Error Analysis – 1.1, 1.2, 1.4
  - Computer Arithmetic, Programming – 1.3
  - Roots of One Nonlinear Equation – 2.1 thru 2.5
  - Roots of Several Nonlinear Equations – 10.1, 10.2
  - Lagrange Interpolation – 3.1, 3.2
  - Newton's Divided Differences – 3.3
  - Splines and Curves – 3.5, 3.6
  - Exam 1 – Monday February 4, 2013

- **Part II – Numerical Calculus and Differential Equations: 5 weeks**

  - Trapezoidal, Simpson, and Gaussian Quadrature for Integrals – 4.1, 4.2, 4.3, 4.5
  - Multiple and Improper Integrals – 4.7, 4.8
  - Differences for Derivatives and Analysis of Errors – 4.9
  - One-Step Methods for Initial Value Problems – 5.1, 5.2, 5.3
  - Multi-Step Methods and Systems – 5.4, 5.5
  - Introduction to Boundary Value Problems – 11.1, 11.2, 11.3
  - Introduction to Partial Differential Equations – 12.1, 12.2, 12.3
  - Exam 2 – Monday March 18, 2013

- **Part III – Linear Equations and Least Squares: 4 weeks**

  - Theory of Solutions of Linear Equations and Row Operations – 6.1, 6.4
  - Gaussian Elimination and Variations – 6.2, 6.3, 6.5
  - Introduction to Eigenvalue Problems – 7.1, 7.2, 7.3
  - Iterative Solution of Linear Equations – 7.4
  - Linear and Nonlinear Least Squares Models – 8.1, 8.2, 8.3
  - Course Summary and Evaluation of Instruction During Last Week
  - Exam 3 – Wednesday April 17, 2013

Important Dates (No Class): January 21, 2013 – MLK Holiday and February 25 & 27 – Spring Break Week.