TEXAS A&M UNIVERSITY

SYLLABUS

Course title and number	OCEN 689 (cross listed as AERO 689)
Term	Fall 2019
Meeting times and location	Tuesday's and Thursday's 2:20pm-3:35pm in HEB 104

Course Description and Prerequisites

Scientific computing and numerical analysis for the physical sciences and engineering. Recommended for students who have some prior undergraduate numerical analysis experience. Topics include: 1D and multi-D interpolation, numerical integration in 1D and multi-D including adaptive quadrature, numerical solutions of ordinary differential equations (ODEs) including stability analysis, numerical solutions of 1D and multi-D linear and nonlinear partial differential equations (PDEs) including concepts of stability and accuracy. Prerequisites: linear algebra, calculus, and some coding experience in an environment such as MATLAB or GNU Octave.

Learning Outcomes or Course Objectives

1. Classify and formulate equations governing flow, transport and/or mechanics in several natural and engineering processes including viscous fluid flow and heat diffusion problems.
2. Distinguish the good, bad and the ugly in numerical approaches:
   - Experiment with a range of numerical methods for interpolation, integration and discretization.
   - Explore how numerical errors affect the quality of the computed solutions, and discover when numerical accuracy deteriorates to the point that computed solutions are not useful.
3. Recognize the challenges in accurately simulating nonlinear problems and select appropriate numerical approaches for such problems.
4. Design your own numerical code to tackle a substantial problem.

Instructor Information

Name	Freddie Witherden
Telephone number	(979) 458-2672
Email address	fdw@tamu.edu
Office hours	Sunday, 4-6pm
Office location	HEB 206

Textbook and/or Resource Material

The course will take the format of "chalk and talk." No typed notes will be provided and students are strongly encouraged to take their own notes in class. Where appropriate references to additional reading material will be provided in class. Although no textbook is required, the classic "Analysis of Numerical Methods" by Isaacson & Keller is recommended and can be found inexpensively online. A more recent, albeit pricey, resource is "Fundamentals of Engineering Numerical Analysis" by Moin.

Grading Scale

Your final grade will be based on:

1. Eight quizzes, these will take place on certain Thursday afternoon lectures starting in Week 2. These quizzes are 20 minutes long and are graded on a pass/fail basis with each pass awarding 12 points.

2. Four take-home assignments. Each assignment will be graded out of 45 points.
3. A final project. The project will be graded out of 124 points.

Out of 400 assignable points:

A = 360-400 points
B = 320-359 points
C = 280-319 points
D = 240-279 points
F = <240 points

Grading Policies

All deadlines are final and, outside of exceptional circumstances, no quarter will be given. Similarly, exceptional circumstances notwithstanding, there will be no opportunity to reschedule quizzes. All students *will* be given the opportunity to turn a failed quiz into a pass through attending an office hour.

Please note that the course has a strict "no quibbling" policy when it comes to how assignments are graded. Should a student object to how a question has been graded, and should that objection be overruled, then the student will incur a penalty of 5 points.

Course Topics, Calendar of Activities, Major Assignment Dates

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Part 1: *Aug 26 – Sept 24*
Foundations

- Interpolation in 1D and multiple dimensions
- Numerical differentiation
- Numerical Integration
- Richardson extrapolation and adaptive quadrature

Assignment 1 handed out:	*Sept 3*
Assignment 1 due:	*Sept 17*
Assignment 2 handed out:	*Sept 17*
Assignment 2 due:	*Oct 1*

Part 2: *Sept 26 – Oct 29*
ODEs

- Numerical Solution of ODEs
- Explicit and implicit Euler
- Runge-Kutta methods
- Stability for various ODE solvers
- Multi-step methods
- Nonlinear ODEs
- Systems of ODEs

Assignment 3 handed out:	*Oct 1*
Assignment 3 due:	*Oct 15*
Assignment 4 handed out:	*Oct 31*
Assignment 4 due:	*Nov 14*

Part 3: *Oct 31 – Dec 5*
PDEs

- Boundary value problems
- Discretization in space and time
- Stability concepts in PDEs
- Nonlinear PDEs in 1D: Burgers
- Conservative discretization
- PDEs in multiple dimensions
- Stability for nonlinear PDEs and IBVPs
- Linear and nonlinear solvers

Project handed out:	*Oct 24*
Project due:	*Dec 11*

Americans with Disabilities Act (ADA)

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 contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information, visit http://disability.tamu.edu.

Academic Integrity

For additional information please visit: http://aggiehonor.tamu.edu

"An Aggie does not lie, cheat, or steal, or tolerate those who do."