TAM 470/CSE 450
Final Exam Information and Review

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Fall 2024

Important Info

- 180 minute written exam on **Wednesday Dec 18, 7-10pm, 218 Ceramics (usual classroom)**

- Arrive early as **we will start promptly at 7pm**.

- Closed book/notes; Equation sheet provided (posted to Canvas), this will be printed out and distributed to you at the exam.

- Scientific or graphing calculator is recommended but not required. Numerical calculations will be light.

- Same exam for both 3 and 4 credit-hour students

- Problems will be in the style of the analysis questions from HW (no coding involved)

Topics

Big picture: the exam will focus on the following core concepts from the course

1. Setting up schemes: can you mathematically write down appropriate schemes for solving an ODE or PDE?

2. Error analysis (leading error term, error behavior with space or time refinement, etc) for finite difference schemes and time integration schemes

3. Stability analysis (linear stability analysis for ODEs; von Neumann and Modified Wavenumber Analysis for PDEs) and interpreting stability diagrams

4. FEM in 1D and 2D (weak form, assembly of element arrays, imposing boundary conditions)

Topics

Finite difference schemes (Moin Ch 2)

- Error analysis
- Significance of leading error term

Numerical solution of ODEs (Moin Ch 4)

- Implementation of schemes (scalar ODEs, nonlinear ODEs, systems of ODEs)
- Converting higher order ODEs into a system of first-order ODEs
- Linear stability analysis
  - Deriving time step restrictions for a scheme
  - Interpreting/using stability diagrams
- RK schemes and multistep schemes
- Implicit methods
- Boundary value problems, implementing boundary conditions

Topics

Numerical solution of PDEs (Moin Ch 5)

- Semi-discretization
- Implementation of time integration for semi-discretized schemes
- Von Neumann and Modified Wavenumber analysis for stability
- Setting up systems of equations for implicit methods (transient problems) or boundary value problems (e.g. steady heat equation)

FEA 1D (Moin Ch 6 – Moin treatment is a little different than mine)

- Derive weak form for 1D ODE/PDE
- Set up and solve Galerkin FEM solution for 1D Poisson equation

FEA 2D (Moin Ch 6 – Moin treatment is a little different than mine)

- Set up and solve Galerkin FEM solution for the steady heat equation with constant body heating and/or heat flux boundary conditions

Tips

Focus on setting up the problem in clear steps. Minor algebra mistakes will be penalized less than conceptual setup/implementation mistakes.

Read instructions carefully. For example if asked to do a derivation, you must show steps leading to a final result, not just produce the result from memory.

Review equation sheet in advance. Make sure you know the meaning and applications of all the equations. Some sections are applicable to multiple topics.

- Equation sheet contains the most common and important information and equations.

- Specific schemes e.g. RK4 would be given on a question, if needed

- You should commit procedural things to memory, e.g. how to assemble FEA arrays

For practice and preparation:

- Review written hw problems and solutions

- Review the sample exam questions on Canvas