MATH 452: Numerical Methods II (4-0-4) 11/19/19

Catalog Description: Numerical solution of ordinary di erential equations. Numerical solution of initial-value problems using Runge-Kutta methods and linear multistep methods; introduction to boundary value problems. Analysis of stability, accuracy, and implementation of methods.

Course Objectives: After completing this course, students will be able to

- 1. Perform each of the methods given below by hand.
- 2. Write code to execute each of the methods given below.
- 3. Compute error information for numerical solutions generated by each of the methods given below.

Learning Outcomes and Performance Criteria

1. Solve rst-order ordinary di erential equations numerically.

Core Criteria:

- (a) Use Euler's Method to solve a rst order initial value problem.
- (b) Use the second order Runge Kutta method to solve a rst order initial value problem.
- (c) Use the fourth order Runge Kutta method to solve a rst order initial value problem.
- (d) Use the backward Euler method to solve a rst order initial value problem.
- (e) Use the Adams-Bashforth method to solve a rst order initial value problem.

Additional Criteria:

- (a) Use Heun's method to solve a rst order initial value problem.
- (b) Use the Modi ed Euler method to solve a rst order initial value problem.
- (c) Use the Adams-Moulton method to solve a rst order initial value problem.
- (d) Analyze stability and convergence for the methods listed (a) (e) from the Core Criteria.
- 2. Solve systems of rst-order ordinary di erential equations.

Core Criteria:

- (a) Compute the characteristic polynomial to nd if a given method is stable.
- (b) Determine if a given system of ordinary di erential equations is sti .
- (c) Approximate the eigenvalues of a matrix numerically by the power method.
- (d) Solve a system of initial value problems numerically with the following methods:

Euler's Method,

the second order Runge Kutta method,

the fourth order Runge Kutta method.

(e) Solve a boundary value problem numerically by the shooting method.

(f) Solve a boundary value problem numerically by nite di erences.

Additional Criteria:

- (a) Calculate the eigenvalues and eigenvectors of a matrix.
- (b) Approximate the eigenvalues of a matrix numerically by the Quadratic method.

Updated by - D. Deb, T. Fogarty, C. Negoita, R. Paul, and J. Fischer.