

M439 Numerical Analysis Review Guide for 3rd Exam

Test Date: Friday November 21st

You may bring in one page of notes (front and back) for this test hand written in your writing.

Numerical Differentiation:

Outline how the 2nd degree Newton Polynomial can be differentiated to generate either the central or forward difference formula

Numerical Integration

Be able to apply Composite Trapezoidal or Composite Simpson Rule to a numerical integration problem.

Error Analysis for Trapezoid and Simpson -- be able to apply the Error formulas to 1) determine the number of subintervals required to achieve the desired accuracy or 2) determine an upper bound on the accuracy of a numerical approximation to an integral. Predict using big-O bounds how the error should decrease when size of interval h is reduced by a factor of $\frac{1}{2}$ (or $1/10$)

Differential Equations

Know what a differential equation is; what an initial value problem is.

Be able to show that a given function is a solution to an initial value problem.

Be able to solve simple separable differential equations (with or without initial conditions) like those assigned.

Use Euler's, Heun's, and the fourth order Runge-Kutta method to numerically approximate solution to differential equation. (One or two steps)

Explain Euler and Heun geometrically. Know the order of each (errors); advantages, and disadvantages of methods. Predict how error will decrease as step size is halved (or reduced by a factor of $1/10$)

Outline the derivation of Huen's method as we did in class including how the Fundamental Theorem of Calculus and the Trapezoid rule are used.

Take a 2nd order differential equation and write it as a system of two first order differential equations.

Explain or apply to a problem one of the methods Euler, Heun, or Runge-Kutta to a system of two first order differential equations. (One or two steps).