

Numerical Methods in Engineering Sciences
25/1/2024

First name: _____

Last name: _____

Student ID: _____

- I want to take the BASIC EXAM (maximum grade is 24/30)
 I want to take the ADVANCED EXAM (maximum grade is 30/30 cum laude)

Total time is 1 hour.

BASIC EXAM

1. Apply the Gaussian elimination method, without pivoting, to solve the linear system $Ax = b$, where

$$A = \begin{bmatrix} -4 & -2 & 1 \\ -4 & 2 & -1 \\ -20 & 6 & -7 \end{bmatrix}, \quad b = \begin{bmatrix} 1 \\ 7 \\ 17 \end{bmatrix}$$

2. Write the pseudo-code of the Newton Method. Apply two Newton iterations to compute an approximate solution of the equation

$$x^3 + x - 2 = 0, \quad \text{starting with } x_0 = 0$$

ADVANCED EXAM

3. Write the pseudo-code of the composite trapezoidal quadrature rule, then use the composite trapezoidal quadrature rule to compute an approximation of

$$\int_0^2 (t^2 - t) dt$$

by splitting the integration interval $[0, 2]$ into four uniform subintervals. Report the intermediate computations.

4. Write the pseudo-code of the “power method” for computing the dominant eigenvalue and eigenvector and describe a possible stopping criterion. State and prove the theorem on the convergence of the method to the dominant eigenvalue (biggest in module).