Çankaya University
Mcs 331 Numerical Methods
Midterm Examination
Dec 01, 2014 13.20 – 15.10
Good Luck!

NAME-SURNAME:

SIGNATURE:

ID:

DEPARTMENT:

DURATION: 110 minutes

◇ **Answer all the questions.**
◇ **Write the solutions explicitly and clearly. Use the numerical terminology.**
◇ **You are allowed to use Formulae Sheet.**
◇ **Calculator is allowed.**
◇ **You are not allowed to use any other electronic equipment in the exam.**

Question	Grade	Out of
1A		10
1B		10
2		20
3		20
4		30
5		20
TOTAL		110

1. A) An engineer runs *the same* FORTRAN program on two different computers, a PC and a UNIX Workstation. Neither system produces any error messages, but the resulting outputs differ by several orders of magnitude more than machine precision. What, if any, reasonable explanations are there for this phenomenon?

   B) How many iterations of bisection will be required to attain an accuracy of 10^{-4} if the starting interval is $[0, 1]$?

2. Consider the function $f(x)$, on $[0, 1]$, defined by

$$f(x) = \sqrt{x} - cos(x)$$

   i Describe how the secant method determine a smaller sub-interval containing a root.

   ii Apply the secant method to $f(x)$ twice.

3. Consider the function:

$$f(x) = sin(x) - 4 * x + 2$$

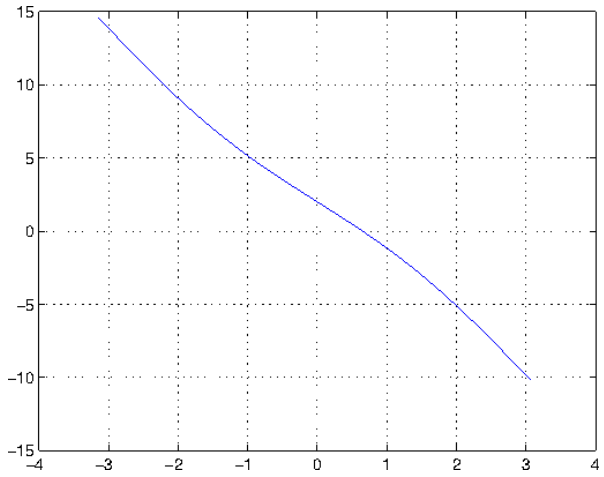

Table 1: Plot of the function, $sin(x) - 4 * x + 2$.

   i Use two iterations of Newton's method to estimate the root of this function between $x = 0.0$ and $x = 1.0$ (Use four significant figures).

   ii Estimate the error in your answer to part i (Use more than four significant figures).

4. Consider the linear system ($Ax = b$);

$$A = \begin{bmatrix} 1 & 3 & 1 & 1 \\ 2 & 5 & 2 & 2 \\ -1 & -3 & -3 & 5 \\ 1 & 3 & 2 & 2 \end{bmatrix} \quad \textit{and} \quad b = \begin{bmatrix} 6 \\ 2 \\ 4 \\ 3 \end{bmatrix}$$

   i Solve this system by Gaussian elimination with pivoting. How many row interchanges are needed?

   ii What is the value of determinant?

   iii Obtain the LU decomposition of the system.

   iv Repeat without any row interchanges (only for the first item). Do you get the same results? Why?

5. Consider the linear system

$$\begin{aligned} 7x_1 - 3x_2 + 4x_3 &= 6 \\ -3x_1 + 2x_2 + 6x_3 &= 2 \\ 2x_1 + 5x_2 + 3x_3 &= -5 \end{aligned}$$

   i Solve this system with the Jacobi method. First rearrange to make it diagonally dominant if possible. Use $[0, 0, 0]$ as the starting vector.

   ii Repeat with Gauss-Seidel method. Compare with Jacobi method.