National University of Computer & Emerging Sciences, Karachi
Department of Computer Science
Final Exam FALL 2022
Thursday December 22 2022, 8.30 am - 11:30 am

Course Code: CS-2008	Course Name: Numerical Computing
Instructor Name: Shahid Ashraf	Total Marks:50
Student Roll No:	Section No:

Question 1 (CLO1) 6+4 marks

a Find the square root of 12 using the Newton Raphson method by deriving the formula

$$x_{i+1} = \frac{1}{2}\left(x_i + \frac{12}{x_i}\right)$$

assuming $x_0 = 1.$ with error $e = 1e-6$, In your table show the relative and absolute error.

b Reiterate the previous question and approximate solution numbers to three digits using rounding and chopping and taking these new values for next iteration.

Question 2 (CLO2) 6+6+2+6 marks

a Find the solution of following system of equations by Gauss-Seidal method

$$A = \begin{bmatrix} 8 & -4 & -1 \\ -4 & 10 & -2 \\ -1 & -2 & 6 \end{bmatrix}, b = \begin{bmatrix} -5 \\ 24 \\ -1 \end{bmatrix}$$

Tolerence criterion is Absolute error $\leq 10^{-3}$, Initial Guess= $[0, 0, 0]$ Residual or relative residual is not required

b Find the solution of the system given by A and b in part a) by LU decomposition Method.

c Compare the solution obtained by Gauss-Seidal method and LU decomposition Method, and comment on the type of method and efficency.

d Find the dominant eigen value of the matrix A given in part a) with the help of Power Method. *(N.B: procedure requires minimum of five to seven iteration to converge)*

Question 3 (CLO2) 5+5 marks

a Using the Runge-Kutta method of fourth order, solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ with $y(0) = 1$ at $x = 0.2, 0.4.$

b Use the golden section search to find the value of x that minimizes $f(x) = x^4 - 14x^3 + 60x^2 - 70x$ in the range $[0, 2]$

Question 4 (CLO2) 5+5 marks

a Suppose that $x_0 = 0, x_1 = 2,$ *and* $x_2 = 4$, and that f is the function defined by the formula

$$f(x) = x^3$$

. Find the coefficients $a_0, a_1,$ *and* a_2 such that the polynomial p defined via the formula

$$p(x) = a_0 + a_1(x - x_0) + a_2(x - x_0)(x - x_1)$$

interpolates the function f at the points x_0, x_1 *and* x_2.

b Use the trapezoidal rule to estimate $\int_0^1 x^2 dx$ using four sub-intervals. Also calculate the absolute and relative error in the estimate.