National University of Computer and Emerging Sciences, Lahore Campus

Course:	Numerical Computing	Course Code:	CS 325
Program:	BS CS	Semester:	Fall 2020
Duration:	1.5 hours	Total Marks:	60
Paper Date:	November 23; 2020	Weight	20%
Section:	All	Page(s):	03
Exam:	Sessional - II	Instructors: Dr. Mubashir Qayyum, Iqra Yaqoot, M Shoaib	
Instruction/Notes:	Attempt All Questions.		

Q1(A) **Points (5)**

Find the minimum number of iterations needed by the bisection algorithm to approximate the root $x = 3$ of $x^3 - 6x^2 + 11x - 6 = 0$ with error tolerance 10^{-3}.

Note: Use general Form and Find the number of iterations only.

(B) **Points (5)**

Develop Newton's method to compute the following:

(a) $\ln(a)$ (natural log of a) $(a > 0)$ (b) $\arccos a$

(C) **Points (5)**

(Applied) Consider the van der Walls equation of state:

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

Use Newton's method to compute the specific volume V of *carbon dioxide* at a temperature of $T = 300°$K, given $P = 1$ atom, $R = 0.082054$ J (kg°K), $a = 3.592$ Pa·m^6/kg^2, $b = 0.04267$m^2/kg.

Obtain the initial approximation V_0 from the ideal gas law: $PV = RT$.

(D) **Points (10)**

Find third approximate positive root of the equation $x^3 - 4x - 9 = 0$ using fixed point iteration process.

PTO

Q2 **Points (10)**

Find the solution by Gauss Jacobi's Method by taking TWO iterations with intial estimates $x^{(0)} = 0$ for the following linear system. Then use the obtained solution (Jacobi's solution after 2nd Iteration) as an initial estimate, and perform ONE iteration of Gauss-Seidal Method for finding the approximate solution.

$$\begin{bmatrix} -1 & 3 & 1 \\ 2 & 2 & 5 \\ 4 & 1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} -4 \\ 1 \\ 5 \end{bmatrix}$$

Q3(A) **Points (15)**

Solve the system given in **Question 2** using Doolittle Method.

(B) **Points (10)**

Solve the following system using Gauss Elimination with Partial Pivoting Method

$$\begin{bmatrix} 4 & 10 & 8 \\ 10 & 26 & 26 \\ 8 & 26 & 61 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 44 \\ 128 \\ 214 \end{bmatrix}$$

Note: If partial pivoting criterial fails at any step of elimination, then in such a step switch the criteria to total pivoting.

$$a_{ij}^{(k+1)} = a_{ij}^{(k)} - \left[\frac{a_{ik}^{(k)}}{a_{kk}^{(k)}}\right] a_{kj}^{(k)} \qquad i,j = k+1, k+2, \ldots, n$$

$$b_i^{(k+1)} = b_i^{(k)} - \left[\frac{a_{ik}^{(k)}}{a_{kk}^{(k)}}\right] b_k^{(k)} \qquad i = k+1, k+2, \ldots, n$$