National University of Computer & Emerging Sciences, Karachi
FAST, School of Computing,
Spring, 2023
Mid Term-I
1st March, 2023, 10:00 am – 11:00am

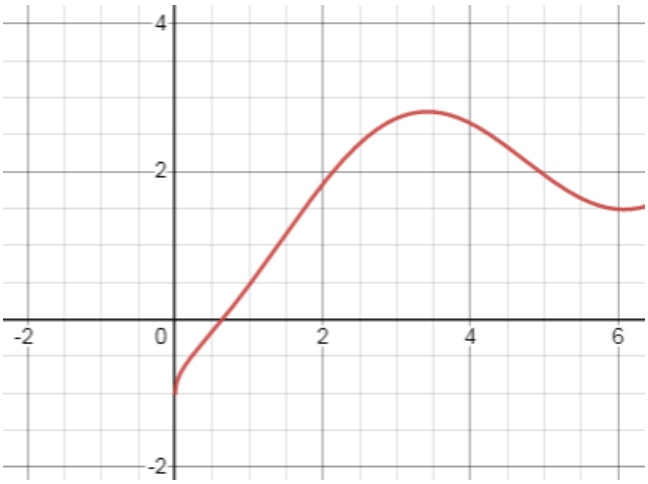
Course Code: CS 2008	**Course Name: Numerical Computing**
Instructor Names: Ms. Amber Shaikh, Mr. Usama Antuley, Mr Shahid Ashraf and Mr. Moheez	
Student Roll No:	**Section :**

Instructions:

- Solve all questions and return the question paper.
- Read each question completely before answering it.
- This paper consists of 3 pages and 4 Questions.
- All the required formulas are on attached paper.

Time: 60 minutes. **Total Marks:**30

Qno1 – CLO 1 2+2+1 Marks



What will be the approximated root of above function by using only one iteration of given method on graph?
a) Bisection method starting with [0,4] also indicate the interval after one iteration.
b) False Position starting with [0,4] also indicate the interval after one iteration.
c) Secant starting with [2,4].

Qno2– CLO 2 5+5 Marks

a) Use Newton forward difference formula to construct interpolating polynomial of degree 2 and interpolate at x =1.1
b) Use Newton backward difference formula to construct interpolating polynomial of degree 2 and interpolate at x=2.4

x	f(x)
1.5	22.0
2.0	17.8
2.5	14.2
1.0	38.3

Qno3 – CLO 1 (6+4) Marks

A data base file memory is related to time i.e, $N(t) = t^3 + 4t^2$, where $N(t)$represent number of bytes and t represents time.

a)Find the time at which file memory reach 10 bytes by using Fixed point iteration method? formula for $g(t) = t - \frac{t^3+4t^2-10}{3t^2+8t}$ with starting point $t = 1.5$ and absolute error < 0.00001.

b) Also show that g(t) is mapping on itself on the interval of [1,2] and $|g'(t)| < 1$.

Qno4 – CLO 3 (1+1+2+1) Marks

Below is the Python function to find the root of the equation.$f(x) = x^2 - 10Cos(x)$

a) Write the lines of code that will be necessary to run the program and getting the output.

b) Solve the program manually by taking starting point = 0 and tol=0.0001 with max iteration = 10 What will be the output (according to given code)

c) Solve the program by taking starting point =1 and tol=0.0001 with max iteration=10. What will be the out put according to the given code.

d) Identify the name of method, number of iterations (in step b and c) and root (in step b and c) if any.

```
import numpy as np
from tabulate import tabulate
def find_root(func, dfunc, x0, tol, max_iter):
    xr = x0
    data=[]
    iter = 0
    es = tol + 1
    for i in range(max_iter):
        iter+=1
        fx = func(xr)
        dx = dfunc(xr)
        if abs(dx) < tol:
           raise Exception("Derivative is close to zero!")
        xrold=xr
        xr = xr - fx/dx
        es=abs(func(xr))
        data.append([iter,xr,func(xr)])
        if es < tol:
           print(tabulate(data,headers=['Iteration','xr','f(xr)'],tablef))
             print('\nRoot of given function is x=%.9f in n=%d number of
                   iterations with a tolerence=%.4f' %(xr,iter,tol))
           return
      raise Exception("Max iterations reached")
```

National University of Computer & Emerging Sciences, Karachi
Department of Computer Science
Formula Sheet

Secant Method

$$p_{n+1} = p_n - f(p_n) * \frac{p_n - p_{n-1}}{f(p_n) - f(p_{n-1})}$$

False Position Method

$$x_k = \frac{a * f(b) - b * f(a)}{f(b) - f(a)}$$

Forward Differnce

$$P_n(x) = P_n(x_0 + sh) = f[x_0] + shf[x_0, x_1] + s(s-1)h^2 f[x_0, x_1, x_2] + s(s-1)(s-2)h^3 f[x_0, x_1, x_2, x_3] + \dots$$

$$P_n(x) = P_n(x_0 + sh) = y_0 + s\Delta(y_0) + \frac{s(s-1)}{2!}\Delta^2(y_0) + \frac{s(s-1)(s-2)}{3!}\Delta^3(y_0)\dots$$

Backward Differnce

$$P_n(x) = P_n(x_0 + sh) = f[x_n] + shf[x, x_{n-1}] + s(s+1)h^2 f[x_n, x_{n-1}, x_{n-2}] + s(s+1)(s+2)h^3 f[x_0, x_1, x_2, x_3] + \dots$$

$$P_n(x) = P_n(x_0 + sh) = y_0 + s \bigtriangledown (y_0) + \frac{s(s+1)}{2!} \bigtriangledown^2 (y_0) + \frac{s(s+1)(s+2)}{3!} \bigtriangledown^3 (y_0)\dots$$

THE END