

## Mahindra University Hyderabad École Centrale School of Engineering End-Semester Regular Examination (2021 - Batch)

Branch: AI, CAM, CE, CSE, ECE, NT Year: 11 Semester: II Program: B. Tech. Subject: Numerical Methods (MA2208)

Date: 08/06/2023

Time Duration: 3 Hours

Start Time: 10:00 AM

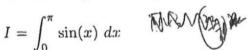
Max. Marks: 100

### Instructions:

- All questions are compulsory.
- Use of non-programmable calculator is allowed.

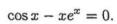
#### Question 1 (20 marks)

(a) Write down a pseudocode to implement the Composite Trapezoidal rule for approximating



by dividing the domain of integration into 10 equal parts.

(b) Write down a pseudocode to implement the Secant method for finding root of the equation



Start the iteration with the initial values  $x_0 = 0, x_1 = 1$  and iterate 10 times.

#### Question 2 (20 marks)

Use the Simpson's 1/3 rule with (a) four, and (b) eight subintervals to approximate the integral

$$\int_{\frac{\pi}{2}}^{\pi} \frac{\sin 2x}{3 - e^{-|x|}} \ dx.$$

## Question 3 (20 marks)

- (a) Perform three iterations to solve  $\frac{dy}{dx} = y x^2 + 1, 0 \le x \le 2, y(0) = 0.5$  using Taylor's method of order 2 with step size h = 0.2. Then find pointwise errors with respect to the exact solution  $y(x) = (x+1)^2 - 0.5e^x$ .
- (b) Find the stability condition to fix step size (h) for solving  $\frac{dy}{dx} = -10y, 0 \le x \le 1, y(0) = 1$ , using Runge-Kutta method of order 4.
- Yestion 4 (20 marks)
  - (a) Perform 4 iterations of Newton-Raphson method to find the root of the equation

$$f(x) = x^3 - 17 = 0$$

taking the initial approximation as  $x_0 = 2$ .

(b) Perform 4 iterations of bisection method to find root of  $f(x) = x^2 - 3$ , starting with the



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# Question 5 (20 marks)

(a) The water level in the sea is mainly determined by tide, whose period is about 12 hours. The height H(t) thus roughly has the form

$$H(t) = a + b\sin(\pi t/6) + c\cos(\pi t/6),$$

where time t is measured in hours. Use the method of least square to the following measurement data to find the constants a, b and c in H(t).

t	0	2	4	6	8	10
H(t)	1.2	1.6	1.4	0.6	0.4	0.2

(b) Obtain the least square approximation for  $f(x) = x^2, x \in [0, 1]$  using Legendre polynomial of degree two. Also, find the least square error (also known as mean squared error).