

Unit 6 - Week 4: Nonlinear Equations in Single Variable

Course outline

How to access the portal?

Course Pre-requisites and Introduction

Week 1 - Computation and Error Analysis

Week 2 - Linear Systems and Equations

Week 3 - Linear Equations - 2

Week 4: Nonlinear Equations in Single Variable

- Introduction to Nonlinear Equations
- Bisection Method
- Analysis of Bisection Method
- Bonus: Excel Solution for Bisection Method
- Regula-Falsi Method
- Bonus: Excel Solution for Regula-Falsi Method
- Regula-Falsi vs. Secant Method
- Bonus: Excel Solution for Secant Method
- Some special cases
- Quiz : Assignment 4**
- Solution to Assignment-4
- Numerical Methods for Engineers : Week 4 Feedback form

Week 5: Nonlinear equations in Single and Multiple Variables

Week 6: Regression (Curve Fitting)

Week 7: Interpolation

Week 8: Numerical Differentiation

Week 9: Numerical Integration

Week 10: Ordinary Differential Equations – Initial Value Problems (ODE-IVP)

Week 11: ODE-IVP (Part-2)

Week 12: ODE - Boundary Value Problems

Video Download, Live Session and Other Information

Info about our Final Exam

Assignment 4

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2019-08-28, 23:59 IST.

In the following three problems, we will consider model of a continuous stirred reactor where a chemical reaction $A \rightarrow B$ takes place. The following model describes the system $\frac{C_{in} - C_A}{\tau} - \frac{k\sqrt{C_A}}{K + C_A} = 0$

where, $k = 1$, $K = 0.25$, $C_{in} = 1$, $\tau = 0.25$. Note that C_A is the only unknown quantity You will solve the above nonlinear equation using Bisection, Regula-Falsi and Secant methods in the problems below

Problem 1: Bisection Method

Starting with initial guesses of $C_A^{(l)} = 0$ and $C_A^{(r)} = 1$, use the bisection method to obtain the solution C_A . Please report the results as described below, accurate to three significant digits

- 1) Please report the value of C_A after the first iteration

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.49,0.51

0.25 points

- 2) Please report the value of C_A after the second iteration

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.74,0.76

0.25 points

- 3) Please report the value of C_A after the third iteration

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.87,0.88

0.25 points

- 4) Please continue Bisection method until the method converges with a tolerance of $\epsilon = 0.001$. Please report the converged solution

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.785,0.787

0.25 points

Problem 2: Regula Falsi Method

Starting with initial guesses of $C_A^{(l)} = 0$ and $C_A^{(r)} = 1$, use the Regula-Falsi method to obtain the solution C_A . Please report the results accurate to three significant digits

- 5) Please report the value of C_A after the first Regula-Falsi iteration

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.831,0.835

0.25 points

- 6) Please report the value of C_A after the second Regula Falsi iteration

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.796,0.800

0.25 points

- 7) Please report the value of C_A after the third Regula Falsi iteration

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.787,0.791

0.25 points

- 8) Please report the value of C_A after the fourth Regula Falsi iteration

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.785,0.789

0.25 points

Problem 3: Secant Method

We will repeat the above problem, but this time, with Secant method. Choose $C_A^{(-1)} = 0$ as the first initial guess and $C_A^{(0)} = 1$ as the second initial guess

- 9) Please report the value of C_A after the first Secant method iteration

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.831,0.835

0.33 points

- 10) Please report the value of C_A after the second Secant method iteration

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.785,0.787

0.33 points

- 11) Please report the value of C_A after the third Secant method iteration

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.785,0.787

0.34 points

Problem 4: Result Comparison

Consider an equation:

$$x^3 + x^2 - 2 = 0$$

Find the root of the equation in the range $x \in [0, 1.5]$ using both bisection method and regula falsi method and report the absolute value of difference in the obtained values from both methods after first and second iterations, i.e. report the value of:

$$|x^{Bisection(i)} - x^{Regula(i)}|$$

- 12) Please report the difference in the values obtained after the first iteration. Please report the result up to three decimal places.

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.213,0.220

0.5 points

- 13) Please report the difference in the values obtained after the second iteration. Please report the result up to three decimal places

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 0.295,0.305

0.5 points

Problem 5: Application Problem

Consider the following situation in which $Q_{in} = 50$ l/s of liquid is flowing into a cylindrical tank of cross-sectional area $A = 5m^2$. The outlet from the tank depends of the liquid height in the tank as $Q_{out} = 5 \times h^{2.5}$. The mass conservation equation is: $Q_{in} = Q_{out}$

Rewrite the above equation in the form $f(h) = 0$. With the initial guesses $h^{(-1)} = 0$ and $h^{(0)} = 1.5$, use the Secant Method to find the height of water in the tank. Please report the results accurate to two digits after the decimal

- 14) What is the height of liquid after 1st Secant method iteration

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 5.42,5.46

0.33 points

- 15) What is the height of liquid after 2nd Secant method iteration

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 1.91,1.95

0.33 points

- 16) What is the height of liquid after 3rd Secant method iteration

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 2.15,2.25

0.34 points