MT 5103: Mathematics for Robotics

Assignment 3

Due Date: October 10th, 2023

Root Solving, Numerical Differentiation, Numerical Integration, Ordinary Differential Equations

1) Find the root of $f(x) = e^{-x}(3.2\sin(x) - 0.5\cos(x))$ on the interval $[3, 4]$. ***(Solve upto 6 iterations).***

2) Solve $f_1(x) = 4 - 8y_2 + 4y_3 - 2y_2^3 = 0$;
$f_2(x) = 1 - 4y_2 + 3y_3 + y_3^2 = 0$
using the Newton-Raphson technique, starting with
$y^{(1)} = \left[y_2^{(1)}\ y_3^{(1)}\right] = [0.5\ 0.5]$; ***(Solve upto 5 iterations)***

3) Solve $f(x) = x^2 + 2\sin(x) + \cos(x)$ using the secant- method by considering initial approximations as $x_0 = 0$ *and* $x_1 = -0.1$. ***(Solve upto 6 iterations).***

4) Find the value of cos (1.74) from the following table:

x:	1.7	1.74	1.78	1.82	1.86
sin(x)	0.9916	0.9857	0.9781	0.9691	0.9584

5) The distance covered by a rocket in meters from $t = 8$ *s* to $t = 30$ *s* is given by

$$x = \int_8^{30} \left(2000 \ln\left[\frac{140000}{140000 - 2100t}\right] - 9.8t\right) dt$$

a) Using Simpson's 1/3rd rule to find the approximate value of *x*
b) Find the true error, E_t
c) Find the absolute relative true error.

6) Repeat problem 5 with Simpson's 3/8th rule.

7) Solve the following differential equation $\frac{dy}{dx} = yx^2 - 1.2y$, in the interval [0 1], with initial condition as $y(0) = 1$ using Heun's Method with h = 0.5.

8) Repeat problem 7 with 4th Order Runge-Kutta Method.