# ADDENDUM A: Assignments

## A.1 Assignment 01

**ASSIGNMENT 01**
**Due date: Wednesday, 30 April 2025**

***ONLY FOR YEAR MODULE***

1. Consider the differential equation

$$y'(x) = -3x^2y^2, \quad y(0) = 2,$$

which has the analytical solution

$$y = \frac{2}{2x^3 + 1}.$$

Apply the modified Euler method to solve the equation up to $x = 1$ first with steplength $h = 0.2$ and then with $h = 0.1$. At each step make 2 corrections. Also calculate the error at each step.

In your solution include:

(i) description of the algorithms used

(ii) program listing (printout)

(iii) computer results (printout)

(iv) discussion of the results (15)

2. Solve the differential equation

$$\frac{dy}{dx} = 3x + 2y + xy, \quad y(0) = -1$$

by means of the Taylor-series expansion to get the value of $y$ at $x = 0.1$. Use terms up to $x^6$. (10)

3. Consider the system of coupled second-order differential equations

$$\begin{aligned} u'' - (t+1)uv + v' &= \cos t \\ v'' &= u' + uv \end{aligned}$$

with initial conditions

$$u(0) = 2, \quad u'(0) = 1, \quad v(0) = 3, \quad v'(0) = -1.$$

Use the second-order Runge-Kutta method with $h = 0.2$ and $a = 2/3$, $b = 1/3$, $\alpha = \beta = 3/2$, to find $u$, $u'$, $v$ and $v'$ at $t = 0.2$.

(12)