

Laboratory 6: Approximating Solutions of Differential Equations

1. Solve the following IVPs to find the exact solution and find an approximating solution using iteration method, Taylor series method, Euler numerical method, Runge-Kutta numerical method and compare the obtained results:

(a) $y' = 1 + y^2, y(0) = 1$

(b) $y' = \frac{1}{1-x^2}y + 1 + x, y(0) = 0$

(c) $y' - 2y = -x^2, y(0) = \frac{1}{4}$

2. Find an approximating solution for the following BVP using the *Shooting Method* and compare with the exact solution:

(a) $y'' + y = x^3, y(0) = 1, y\left(\frac{\pi}{2}\right) = 0;$

(b) $y'' + y' = 1, y(0) = 0, y(1) = 1;$

(c) $y'' + 3y' + 2y = \frac{1}{e^x+1}, y(0) = 2 \ln(2) + 2, y(1) = \frac{e+1}{e^2} (\ln(e+1) + 1);$