Project M3 — Solution of Differential Equations

Determine the solution of the differential equation eventually of the system of the equations.

1. For exercises from M3.1 to M3.12:
   - bring in the mathematical description of the method used
   - make your own program to solve the given exercise numerically using Euler method for various steps of the calculation including the specification of the function in the form of a special function subprogram
   - if possible carry out also symbolic solution
   - compare your own solution with the results determined using programs ODE23 and ODE45
2. For exercises from M3.21 to M3.32:
   - bring in the mathematical description of the method used
   - if possible carry out also symbolic solution
   - make the diagram and solve the given exercise in the Simulink environment

Solving this task you can use some of the following functions ODE23, 0DE45, PLOT and also DSOLVE, EZPLOT.

M3.1	$xy' = 2y,$	$y(1) = 0$	M3.21	$y'' + y = 0,$	$y(0) = 0, \quad y'(0) = 1$
M3.2	$y' = 1/x^2 - y/x - y^2,$	$y(1) = -1$	M3.22	$y'' + 4y' + 13y = 0,$	$y(0) = 0, \quad y'(0) = 3$
M3.3	$y' = (x^3 - 2y)/x,$	$y(1) = 0.5$	M3.23	$y'' - 2y' + 2y = exp(t),$	$y(0) = 1, \quad y'(0) = 1$
M3.4	$y' = 2y,$	$y(0) = 1$	M3.24	$y'' + 4y' + 3y = 8exp(t),$	$y(0) = 1, \quad y'(0) = 1$
M3.5	$xy' = -ylog(y),$	$y(1) = 0.5$	M3.25	$y'' + 4y = cos(t),$	$y(0) = 0, \quad y'(0) = 1$
M3.6	$y' = x + y,$	$y(0) = 1$	M3.26	$y'' + 18y' + 81y = 0,$	$y(0) = 3, \quad y'(0) = 2$
M3.7	$y' = -y^2,$	$y(1) = 1$	M3.27	$y'' + 6y' + 9y = 0,$	$y(0) = 1, \quad y'(0) = 0$
M3.8	$y' = y + 7 * y/x,$	$y(1) = 0$	M3.28	$y'' + 16y = 0,$	$y(0) = 0, \quad y'(0) = 1$
M3.9	$y' = y(3 - xy),$	$y(1) = 1$	M3.29	$y'' - 2y' + 3y = 0.1,$	$y(0) = 0, \quad y'(0) = 1$
M3.10	$y' = 5 - 3\sqrt{y},$	$y(1) = 2$	M3.30	$y'' + 4y = 8 * sin(t),$	$y(0) = 1, \quad y'(0) = 1$
M3.11	$y' = \frac{4-xy}{1+y^2},$	$y(0) = -2$	M3.31	$y'' + 8y = 8 * sin(t) - 5 * cos(t),$	$y(0) = 0, \quad y'(0) = 1$
M3.12	$y' = -(y^2 - 1) + y,$	$y(1) = 0$	M3.32	$y'' - 0.5y' + 6y = arcsin(t),$	$y(0) = 0, \quad y'(0) = 1$

Using your own program determine symbolic and numerical value of the derivation and the integration of the given function $f(x)$ in the range of $\langle a, b\rangle$ using division on N segments. The solution includes:

- the mathematical description of the method used
- the numerical integration using selected basic rules (rectangular, trapezoidal, Simpson) and compare your own solution with results determined using programs QUAD a QUAD8
- the choice of the suitable differential formula for the numerical derivation
- graphical illustration of individual steps of integration and differentiation of the given function in a selected interval

Solving this task you can use some of the following functions QUAD, QUAD8 and also INT, DIFF, EZPLOT.

M3.41	$f(x) = \sin x$
M3.42	$f(x) = \cos x$
M3.43	$f(x) = x^2$
M3.44	$f(x) = 3x^2 + 5$
M3.45	$f(x) = x^3 + 5x^2 + 4$
M3.46	$f(x) = 4/x + 6$
M3.47	$f(x) = 3e^x + 5$
M3.48	$f(x) = 4e^{-x} + 2$
M3.49	$f(x) = \sin x + x$
M3.50	$f(x) = \sin x + x^2/3$
M3.51	$f(x) = \cos x + (1/x)^2$
M3.52	$f(x) = e^x$