1. General Initial Value ODE (1x1) Problem

(1.1)

where

*y*= dependent variable

*t* = independent variable

*f(y,t)* = derivative function

*t*0 = initial value of the independent variable

*y*0 = initial value of the dependent variable

The analytical solution:

(1.2)

2. General Initial Value ODE (2x2) Problem

(2.1)

3. Heat Transfer Equation

(3.1)

The analytical solution:

(3.2)

4. Nonlinear Partial Differential Equation

where, in SI (MKS) units,

*u* = insulation temperature, K

*t* = time, s

*x* = position in the insulation, m

*ua* = ambient (flame) temperature, K

*α* = insulation thermal diffusivity, m2*/*s

*k* = insulation thermal conductivity,

*σ* = Stefan–Boltzmann constant = 0

*L* = insulation half thickness, m

*a* = absorptivity

*e* = emissivity

*us* = steel temperature, K

*Ls* = steel half thickness, m

*ρs* = steel density, kg*/*m3

*Cps* = steel specific heat, J*/*kg・K