Matlab for solving differential equations

To solve differential equations with Matlab, we may use the command "dsolve" in the following format:
dsolve('the differential equation', 'the initial condition, if any', 'the variable of differential equation')

Example 1: Find the solution of the following initial value problem
$y^{(4)}(x) - 3y(x)=0$, with the initial condition y(0)=4.

Enter dsolve('D4y - 3*y =0','y(0)=4','x') in the command window. Then we get the solution
C1*exp(-3^(1/4)*x)+(-C1-C4+4)*exp(3^(1/4)*x)-C3*sin(3^(1/4)*x)+C4*cos(3^(1/4)*x)

Notes:

1. In the above solution, C1,…, C4 are arbitrary constants.
2. If dsolve cannot find an analytic solution for an equation, it prints the warning "Warning: explicit solution could not be found" and return an empty sym object.
3. There is no need to rewrite a differential equation based on y(t) or y(x). In the following
 example we find the solution p(s) of a differential equation.

Example 2: Find the general solution of $p''(s)+e^{p(s)}=0$

Entering dsolve('D2p+exp(p) =0','s'), gives
log(-1/2*(-1+tanh(1/2*(s+C2)/C1)^2)/C1^2)
(note that log in Matlab represents the natural log)

Example 3: Find the general solution of $3y''(t)-y'(t)+y=0$

Enter dsolve('3*D2y-Dy+y =0','t') in the command window. We get
C1*exp(1/6*t)*sin(1/6*11^(1/2)*t)+C2*exp(1/6*t)*cos(1/6*11^(1/2)*t)

It is also possible to get the general solution of a differential equation with unknown coefficients.

Example 3: Find the general solution of $-3t\, y''(t)+ky'(t)=0$, where k is a constant.

Enter dsolve('(-3*t)*D2y+k*y=0','t') to get the general solution
C1*t^(1/2)*besselj(1,2/3*(-3*k)^(1/2)*t^(1/2))+C2*t^(1/2)*bessely(1,2/3*(-3*k)^(1/2)*t^(1/2))
Where besselj and bessely are Bessel functions of first and second kinds, respectively.