Problem 1.

(1) Verifying the solution of (1):

We have the following differential equation:

We can rewrite this equation as:

Integrating both sides:

Solving the left-hand integral:

Multiplying both sides by -p:

Solving for p:

Using the initial condition , we get:

Therefore, the solution is given by:

Comparing this solution with the given solution, we can see that they are equivalent.

Writing down the expression for y vs. t:

We have:

Rearranging this expression:

Problem 2.

7 points fit a polynomial of degree 2,

Vandermonde System to solve for *a* coefficient:

Sample points are equally spaced:

;

;

;

X =

1 -3 9

1 -2 4

1 -1 1

1 0 0

1 1 1

1 2 4

1 3 9

>> 21\*inv(X'\*X)\*X'

ans =

-2.0000 3.0000 6.0000 7.0000 6.0000 3.0000 -2.0000

-2.2500 -1.5000 -0.7500 0 0.7500 1.5000 2.2500

1.2500 0 -0.7500 -1.0000 -0.7500 0 1.2500

Computation for coefficients:

Recall Savitzky-Golay filter identifies constant term with filtered value:

7-point quadratic SG filter kernel: