

Homework Assignment - Simulink**Due date : September 19, Wednesday, 2018****Problem 1. [30 points]** Consider this equation to calculate $y(t)$ where t is time in seconds.

$$y(t) = e^{\sin(t)} e^{-0.15 t}$$

Create 4 different simulink models that show $y(t)$ over 30 seconds in a scope.

- 1) Using basic Simulink blocks only
- 2) Using “Fnc” block from “User-Defined Function” library
- 3) Using “Interpreted MATLAB Function” block from “User-Defined Functions” library and an M-file
- 4) Using “MATLAB Function” block from “User-Defined Functions” library

You should name these four simulink models as **sol1.slx**, **sol2.slx**, **sol3.slx**, and **sol4.slx**, respectively. You should name the M-file to be called in **sol3.slx**, **myFunc.m**

Problem 2. [40 points] Consider the following difference equation

$$x(k) + 0.1 x(k-2) + 0.4 x(k-3) = -300 \mathbf{1}(t-2.5)$$

where $\mathbf{1}(t-t_0)$ is a unit step function with step time at $t = t_0$ sec, t is continuous time, and k is the discrete time. The sampling period is 0.1 sec. The initial conditions are

$$\begin{aligned} x(k-1) &= 250 \\ x(k-2) &= -100 \\ x(k-3) &= 200 \end{aligned}$$

Develop a simulink model that solves this difference equation for 5 seconds. Name the simulink model **diffEqSol.slx**. This simulink model should have a scope showing $x(k)$.

Problem 3. [30 points] You are required to develop a simulink model to solve the following set of nonlinear ordinary differential equations (ODE). The set of ODE that to solve or simulate is

$$\dot{p} = -m p + g \exp(q) + u \quad (1)$$

$$\dot{q} = -p^2 + 1/q \quad (2)$$

$$\dot{r} = -g \sin(-0.1 r) \quad (3)$$

where (p, q, r) are the state variables, u is the input variable and m, g are constant parameters ($m = 5, g = 40$). The initial conditions of the state variables are

$$p(t=0) = 3 \quad (4)$$

$$q(t=0) = 2 \quad (5)$$

$$r(t=0) = -1 \quad (6)$$

The input variable is

$$u(t) = 10 * \mathbf{1}(t - 5) \quad (7)$$

(8)

where $\mathbf{1}(t - t_0)$ is unit step that changes from 0 to 1 at t_0 seconds.

In this problem, you need submit two .m files and a simulink file (.slx file) as your solution. The first file should be named **parameters.m**, which is a Matlab-script where you define the parameters of the system. In this case, they are m and g . You need to run this script before you run the simulink model. You run a script by simply typing its name without extension and pressing Enter in Matlab Command Prompt.

The second file is the simulink model, **odeSetSol.slx**.

The third file is **plotScript.m**, used to plot the simulation results. This file should be run similar to **parameters** after the simulation is completed.

SUBMISSION OF YOUR SOLUTIONS TO BLACKBOARD:

You are required put all six Simulink files and three .m-files in a zip-file and upload it to blackboard as your submission.
