Linear Controller Design and State Space Analysis

EEE8013
Tutorial Exercise I

1. By using the general form of the analytic solution try to predict (without solving the ODE) the response of the following systems. Your answer must describe the system as stable/unstable, convergent to zero/nonzero value/sinusoid. Crosscheck your answer by solving the DE:
   - $5\frac{dx}{dt}+6x=0,\quad x(0)=0,\ \dot{x}(0)=1,\ \ddot{x}(0)=-1$
   - $5\frac{dx}{dt}-6x=0,\quad x(0)=0,\ \dot{x}(0)=1,\ \ddot{x}(0)=-1$
   - $5\frac{dx}{dt}+6x=1,\quad x(0)=0,\ \dot{x}(0)=1,\ \ddot{x}(0)=-1$
   - $5\frac{dx}{dt}+6x=-1,\quad x(0)=0,\ \dot{x}(0)=1,\ \ddot{x}(0)=-1$
   - $\frac{dx}{dt}-3=0,\quad x(0)=0,\ \dot{x}(0)=1,\ \ddot{x}(0)=-1$
2. Using numerical solutions crosscheck your previous statements.
3. Simulate the analytic solution and hence crosscheck the results of Q1 and Q2.
4. Find the solution of $\ddot{x}+6\dot{x}+5x=0,\ x(0)=2,\ \dot{x}(0)=3$. Briefly describe how the solution behaves for these initial conditions. Crosscheck the results by using numerical solution. Simulate the analytical solution.
5. Find the solution of $\ddot{x}+2\dot{x}+6x=0,\ x(0)=1,\ \dot{x}(0)=0$. Briefly describe how the solution behaves for these initial conditions. Crosscheck the results by using numerical solution. Simulate the analytical solution.
6. Find the solution of $\ddot{x}-\dot{x}+0.25x=0,\ x(0)=2,\ \dot{x}(0)=1/3$. Briefly describe how the solution behaves for these initial conditions. Crosscheck the results by using numerical solution. Simulate the analytical solution.