EE324, Control Systems Lab, Problem sheet 1
(Submission date: 17th January 2021)

Analysis in Laplace domain:

In Scilab, type the following command in the command prompt:

```
s = poly(0,'s')
```

This defines the symbolic variable 's'. Once 's' is defined we can easily define polynomials in s and rational functions in s in the following manner:

```
f = s^3 + 6*s^2 + 11*s + 6
```

Like the polynomial 'f' above, define two more polynomials 'n' and 'd', and do the following:

```
G = n/d
```

```
sys = syslin('c',G)
```

This defines the continuous time system having transfer function G.

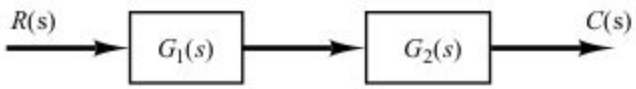
With this background, now solve the following problems:

Q1.Suppose there are two components with transfer functions G1(s) and G2(s) connected differently as shown in Figure(a),(b) and (c), where

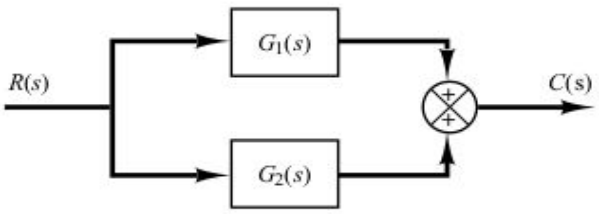
G1(s) = 10/(s^2+2s+10) G2(s) = 5/(s+5)

Obtain the transfer function of the following systems using Scilab. In your report, write down every step that you followed for solving the problem for each of the cases.

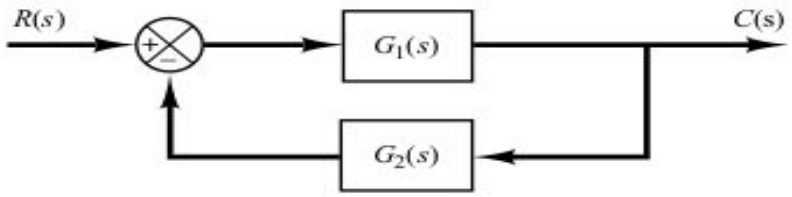
(a) Cascade system :



(b) Parallel system :



(c) Feedback(closed loop) system :



(d) Plot response to the unit step to the system with transfer function G1(s). (Use `csim` command.)

Q2. For each of the cases in Q1, find out the poles and zeros of the overall system (that is, having transfer function C(s)/R(s)). Write down all the steps you followed.
Hint: Find out using Scilab help or otherwise how to obtain roots of a given polynomial.

Scilab is quite powerful in handling polynomials and rational function in the variable s. Scilab can be used to deal with polynomial matrices as well. To start with, define a matrix in Scilab by executing the following command:

```
A = [1 2; 3 4]
```

This defines the 2 x 2 matrix $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

We can likewise define a matrix with polynomial or rational function entries. And then usual matrix operations, like addition, multiplication, taking determinants, inverses, etc. will work for polynomial matrices, too. Try these operations on polynomial matrices. Show your computations in your report.

Now solve the following problem based on these tools.

Q3. Consider the following electrical circuit. Write down the equation that one obtains via mesh analysis, in matrix-vector form $Z(s)I(s) = V(s)$.
Using Scilab, find out the transfer functions $I\_1(s)/V\_1(s)$, $I\_2(s)/V\_1(s)$, $I\_3(s)/V\_1(s)$. Show all the steps in your report.