Name: _____ Roll No: _____

Score: _____ Signature of the Lab Tutor: _____ Date: _____

DEPARTMENT OF ELECTRONIC & TELECOMMUNICATION ENGINEERING
MEHRAN UNIVERSITY OF ENGINEERING & TECHNOLOGY, JAMSHORO
Feedback Control Systems (1st Term, Third Year, 03TL)
Lab Practice # 02

Basic Control Functions

1. Introduction

A linear control system may be presented either by a set of differential equation(s) or by a *transfer function*.

2. Transfer Function

A transfer function is defined as the ratio of the Laplace transform of output to the Laplace transform of the input. The transfer function:

$$G(S) = \frac{100}{S^2+14S+100}$$

Can be stored in the MATLAB workspace by typing
num = 100;
den = [1 14 100];

To check your entry you can use the command *printsys* as shown below:

printsys(num,den);

3. Poles

The poles of the system are the roots of the denominator polynomial (the characteristic polynomial). The poles of the above transfer function can be found by

poles = roots(den);

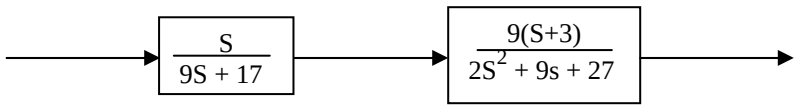
Exercise#1:

(a) Find zeros of above transfer function (if any)
(b) Is the above system stable? Why?
(c) Use the plot function to plot the poles of the above transfer function marked by the symbol 'x'. Record this plot in your lab book with your Roll.No on the top of the plot.

To plot the poles and zeros of any transfer function there is a built in function *pzmap* in the MATLAB. Note that the cross symbol in the figure present poles while the circles represents zeros, which are not shown in this particular plot, because the system has not any zeros.

4. Multiplication of transfer functions

Consider the following block diagram:



These two transfer functions can be multiplied by using the following MATLAB code:

```
num1 = [1  0];
den1 = [9  17];
num2 = 9*[1  3];
den2 =  [2  9  27];
[num12, den12] = series (num1,den1,num2,den2);s
printsys(num12,den12);
```

This transfer function can also be multiplied by using the following code:

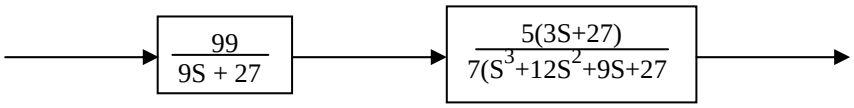
```
num1 = [1  0];
den1 = [9  17];
num2 = 9*[1  3];
den2 =  [2  9  27];
num12 =conv(num1,num2);
den12 = conv(,den1,den2);
printsys(num12,den12);
```

Exercise#2

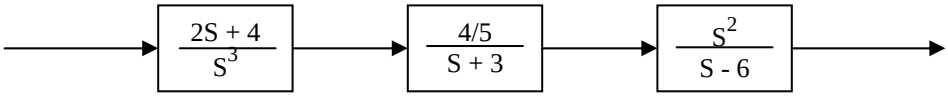
(a) What is the difference between the built-in function “conv” and ”series”?

(b) Reduce each of the following block diagrams into a single block form. In each case find poles and zeros and sketch pole zero diagram. In which block diagrams you cannot use the function “series”? Why? Also determine whether the system is stable or not?

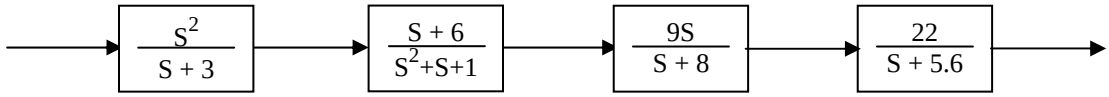
(i)



(ii)

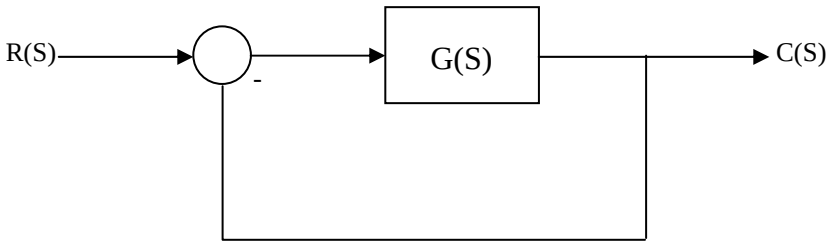


(iii)



5. Closed-loop transfer function

A simple closed loop control system can be represented as shown in the following block diagram.



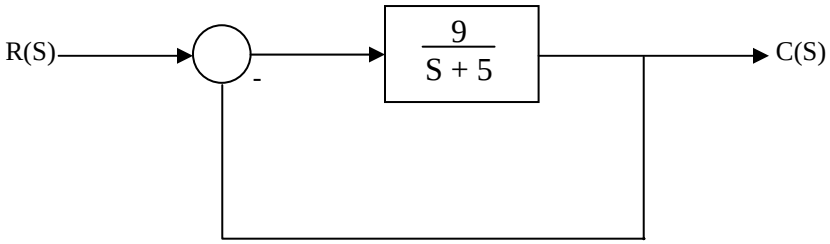
The closed loop transfer function of the above block diagram is given by

$$\frac{C(S)}{R(S)} = \frac{G(S)}{1 + G(S)}$$

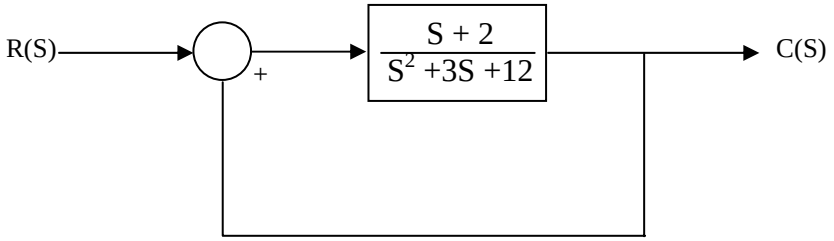
We can obtain this transfer function by using MATLAB functions *cloop* or *feedback*.

Exercise#3

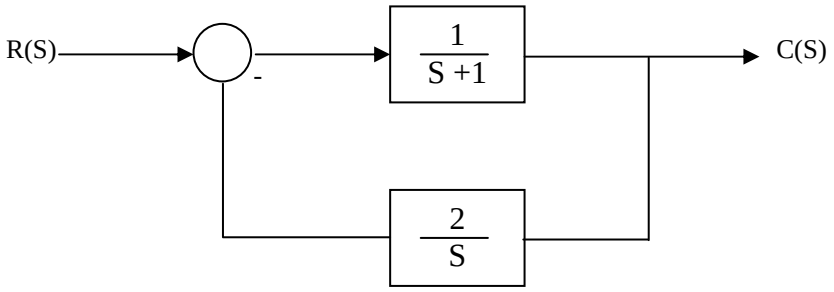
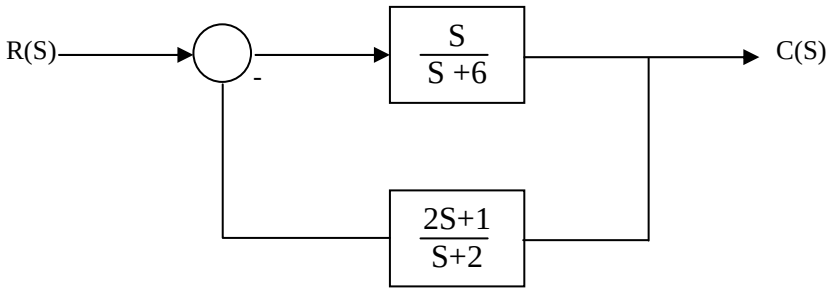
(a) Consider the following block diagram. Find the closed loop transfer function.



(b) Find the closed loop transfer function of the following block diagram.



(c) Find the closed loop transfer function of the following block diagram.



(d) Find the closed loop transfer function of the following block diagram.