**CONTROL SYSTEMS (5th EE & IE)**

**COMPUTER LABORATORY**

**ASSIGNMENT 2:**

**Test 1:** Find the partial fraction expansions of the following using MATLAB:



**Q1:**

**>> num=[0 0 0 6] %Taking input for numerator matrix**

num =

0 0 0 6

**>> den=[1 6 11 6] %Taking input for denominator matrix**

den =

1 6 11 6

**>> [r,p,k]=residue(num,den) %Assign variables for partial fraction**

r =

3.0000

-6.0000

3.0000

p =

-3.0000

-2.0000

-1.0000

k =

[]

**>> [num,den]=residue(r,p,k) %Convert partial fraction expression back into num and den**

num =

-0.0000 -0.0000 6.0000

den =

1.0000 6.0000 11.0000 6.0000

**>> printsys(num,den,'s') %Print original expression**

num/den =

6

----------------------------------

s^3 + 6 s^2 + 11 s + 6

**Q2:**

**>> num=[0 0 120 240]**

num =

0 0 120 240

**>> den=[1 5 7 3]**

den =

1 5 7 3

**>> [r p k]=residue(num,den)**

r =

-30.0000

30.0000

60.0000

p =

-3.0000

-1.0000

-1.0000

k =

[]

**>> [num den]=residue(r,p,k)**

num =

0 120.0000 240.0000

den =

1.0000 5.0000 7.0000 3.0000

**>> printsys(num,den,'s')**

num/den =

120 s + 240

---------------------

s^3 + 5 s^2 + 7 s + 3

**Q3:**

**>> num=[0 0 20 20]**

num =

0 0 20 20

**>> den=[1 5 7 3]**

den =

1 5 7 3

**>> [r p k]=residue(num,den)**

r =

-10.0000

10.0000

-0.0000

p =

-3.0000

-1.0000

-1.0000

k =

[]

**>> [num den]=residue(r,p,k)**

num =

0 20.0000 20.0000

den =

1.0000 5.0000 7.0000 3.0000

**>> printsys(num,den,'s')**

num/den =

20 s + 20

---------------------

s^3 + 5 s^2 + 7 s + 3

**Q4:**

**>> num=[0 0 0 2]**

num =

0 0 0 2

**>> den=[1 7 15 9]**

den =

1 7 15 9

**>> [r p k]=residue(num,den)**

r =

-0.5000

-1.0000

0.5000

p =

-3.0000

-3.0000

-1.0000

k =

[]

**>> [num den]=residue(r,p,k)**

num =

-0.0000 -0.0000 2.0000

den =

1.0000 7.0000 15.0000 9.0000

**>> printsys(num,den,'s')**

num/den =

2

----------------------------------

s^3 + 7 s^2 + 15 s + 9

**Q5:**

**>> num=[0 0 1 2]**

num =

0 0 1 2

**>> num=[0 0 0 1 2]**

num =

0 0 0 1 2

**>> den=[1 1 9 9 0]**

den =

1 1 9 9 0

**>> [r p k]=residue(num,den)**

r =

-0.0611 + 0.0167i

-0.0611 - 0.0167i

-0.1000 + 0.0000i

0.2222 + 0.0000i

p =

0.0000 + 3.0000i

0.0000 - 3.0000i

-1.0000 + 0.0000i

0.0000 + 0.0000i

k =

[]

**>> [num den]=residue(r,p,k)**

num =

0 -0.0000 1.0000 2.0000

den =

1.0000 1.0000 9.0000 9.0000 0

>> printsys(num,den,'s')

num/den =

s + 2

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s^4 + 1 s^3 + 9 s^2 + 9 s

**Test 2:**

1. Find poles, zeros and gain of all the problems given in Test 1
2. For the following poles, zeros and gain, determine transfer functions:
3. zeros at s = -1, -2; poles at s = 0, -4, -6 and gain k = 5
4. zeros at s = 1; poles at s = 0, -2, -1+j0.5, -1-j0.5 and gain k = 10

**Q1:**

**>> num=[0 0 0 6]**

num =

0 0 0 6

**>> den=[1 6 11 6]**

den =

1 6 11 6

**>> [z p k]=tf2zp(num,den)**

z =

Empty matrix: 0-by-1

p =

-3.0000

-2.0000

-1.0000

k =

6

**Q2:**

**>> num=[0 0 120 240]**

num =

0 0 120 240

**>> den=[1 5 7 3]**

den =

1 5 7 3

**>> [z p k]=tf2zp(num,den)**

z =

-2

p =

-3.0000 + 0.0000i

-1.0000 + 0.0000i

-1.0000 - 0.0000i

k =

120

**Q3:**

**>> num=[0 0 20 20]**

num =

0 0 20 20

**>> den=[1 5 7 3]**

den =

1 5 7 3

**>> [z p k]=tf2zp(num,den)**

z =

-1

p =

-3.0000 + 0.0000i

-1.0000 + 0.0000i

-1.0000 - 0.0000i

k =

20

**Q4:**

**>> num=[0 0 0 2]**

num =

0 0 0 2

**>> den=[1 7 15 9]**

den =

1 7 15 9

**>> [r p k]=tf2zp(num,den)**

r =

Empty matrix: 0-by-1

p =

-3.0000

-3.0000

-1.0000

k =

2

**Q5:**

**>> num=[0 0 0 1 2]**

num =

0 0 0 1 2

**>> den=[1 1 9 9 0]**

den =

1 1 9 9 0

**>> [z p k]=tf2zp(num,den)**

z =

-2

p =

0.0000 + 0.0000i

0.0000 + 3.0000i

0.0000 - 3.0000i

-1.0000 + 0.0000i

k =

1

**Q (b) (i):**

**>> z=[-1;-2]**

z =

-1

-2

**>> p=[-3,-1,-1]**

p =

-3 -1 -1

**>> p=[-3;-1;-1]**

p =

-3

-1

-1

**>> k=[5]**

k =

5

**>> [num den]=zp2tf(z,p,k)**

num =

0 5 15 10

den =

1 5 7 3

**>> printsys(num,den,'s')**

num/den =

5 s^2 + 15 s + 10

---------------------

s^3 + 5 s^2 + 7 s + 3

**Q (b) (ii) :**

**>> z=[1]**

z =

1

**>> p=[0;-2;-1+0.5j;-1-0.5j]**

p =

0.0000 + 0.0000i

-2.0000 + 0.0000i

-1.0000 + 0.5000i

-1.0000 - 0.5000i

**>> k=[10]**

k =

10

**>> [num den]=zp2tf(z,p,k)**

num =

0 0 0 10 -10

den =

1.0000 4.0000 5.2500 2.5000 0

**>> printsys(num,den,'s')**

num/den =

10 s - 10

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s^4 + 4 s^3 + 5.25 s^2 + 2.5 s

**Test 3:**

1. Find the transfer functions for the block diagrams using MATLAB commands:

where   

**Given:**



**>> num1=[0 10]**

num1 =

0 10

**>> den1=[1 0]**

den1 =

1. 0

**>> sys1=tf(num1,den1)**

sys1 =

10

--

s

**Given:**



**>> num2=[1 1]**

num2 =

1 1

**>> num2=[0 1 1]**

num2 =

0 1 1

**>> den2=[1 5 0]**

den2 =

1 5 0

**>> sys2=tf(num2,den2)**

sys2 =

s + 1

---------

s^2 + 5 s

**Given:**



**>> num3=[0 0 10]**

num3 =

0 0 10

**>> den3=[1 3 9]**

den3 =

1 3 9

**>> sys3=tf(num3,den3)**

sys3 =

10

-------------

s^2 + 3 s + 9

**Q(a):**

**>> sys=series(sys1,sys2)**

sys =

10 s + 10

-----------

s^3 + 5 s^2

**Q(b):**

**>> sys=parallel(sys1,sys2)**

sys =

11 s^2 + 51 s

-------------

s^3 + 5 s^2

**Q(c):**

**>> sysa = series(sys1,sys2)**

sysa =

10 s + 10

-----------

s^3 + 5 s^2

**>> sysb= series(sysa,sys3)**

sysb =

100 s + 100

-----------------------------

s^5 + 8 s^4 + 24 s^3 + 45 s^2

**Q(d):**

**>> sysc =parallel(sys1,sys2)**

sysc =

11 s^2 + 51 s

-------------

s^3 + 5 s^2

**>> sysd= parallel(sysc,sys3)**

sysd =

11 s^4 + 94 s^3 + 302 s^2 + 459 s

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s^5 + 8 s^4 + 24 s^3 + 45 s^2

2. Find the closed loop transfer functions of negative feedback systems using MATLAB commands:

(a)  and  (b)  and 

**Q(a):**

**>> num1=[0 0 100]**

num1 =

0 0 100

**>> den1=[1 4 0]**

den1 =

1 4

**>> num2=[0 1]**

num2 =

0 1

**>> den2=[1 1]**

den2 =

1 1

**>> sys1=tf(num1,den1)**

sys1 =

100

---------

s^2 + 4 s

>> **sys2=tf(num2,den2)**

sys2 =

1

-----

s + 1

**>> sys= feedback(sys1,sys2)**

sys =

100 s + 100

-----------------------

s^3 + 5 s^2 + 4 s + 100

**Q (b):**

**>> num1=[0 5 15]**

num1 =

0 5 15

**>> den1=[1 3 9]**

den1 =

1 3

**>> num2=[0 2]**

num2 =

0 2

**>> den2=[1 0]**

den2 =

1 0

**>> sys2 =tf(num1,den1)**

sys2 =

5 s + 15

-------------

s^2 + 3 s + 9

**>> sys1 =tf(num1,den1)**

sys1 =

5 s + 15

-------------

s^2 + 3 s + 9

**>> sys2=tf(num2,den2)**

sys2 =

2

-

s

**>> sys=feedback(sys1,sys2)**

sys =

5 s^2 + 15 s

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s^3 + 3 s^2 + 19 s + 30