```
%Studio 00
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%ENME462
%Section 0105
```

Problem 1. Use MATLAB to represent and generate the transfer function

```
% Using Control System Toolbox
'Rational Expression Method, Polynomial Form' %Display Label
s = tf('s'); % Define 's' as an LTI object in polynomial form
G = 5*(s+15)*(s+26)*(s+72)/(s*(s+55)*(s^2+5*s+30)*(s+56)*(s^2+27*s+52))
```

```
ans =

    'Rational Expression Method, Polynomial Form'


G =

                    5 s^3 + 565 s^2 + 16710 s + 140400

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

  s^7 + 143 s^6 + 6849 s^5 + 123717 s^4 + 788690 s^3 + 3.469e06 s^2

                                                          + 4.805e06 s

Continuous-time transfer function.
```

Problem 2. Use MATLAB to generate partial fraction expansion of the following function

```
% Using Control System Toolbox
'Rational Expression Method, Polynomial Form' %Display Label
s = tf('s'); % Define 's' as an LTI object in polynomial form
F = ((10^4)*(s+5)*(s+70))/(s*(s+45)*(s+55)*(s^2+7*s+110)*(s^2+6*s+95))

% Numerator and Denominator from F(s)
numf = (10^4)*poly([-5 -70]);
demf = conv(poly([0 -45 -55]),conv([1 7 110],[1 6 95]));
% K = residue; p = roots of denominator; k = direct quotient
% Use resisdue function for expansion
[K,p,k]=residue(numf,demf)

%In Partial Expansion Form
%F = -(0.0018)/(s+55) + (0.0066)/(s+45) + (0.9513+0.0896i)/(s+3.5-9.8869i) + (0.9513-0.089
6i)/(s+3.5+9.8869i) + (-1.0213 - 0.1349i)/(s+3-9.2736i) + (-1.0213 + 0.1349i)/(s+3+9.2736i
) + (0.1353)/(s)
```

```
disp("F = -(0.0018)/(s+55) + (0.0066)/(s+45) + (0.9513+0.0896i)/(s+3.5-9.8869i) + (0.9513-0.0896i)/(s+3.5+9.8869i)")
```

```
ans =

    'Rational Expression Method, Polynomial Form'


F =

                        10000 s^2 + 750000 s + 3.5e06

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

  s^7 + 113 s^6 + 4022 s^5 + 58200 s^4 + 754275 s^3 + 4.324e06 s^2

                                                              + 2.586e07 s


Continuous-time transfer function.


K =

  -0.0018 + 0.0000i
   0.0066 + 0.0000i
   0.9513 + 0.0896i
   0.9513 - 0.0896i
  -1.0213 - 0.1349i
  -1.0213 + 0.1349i
   0.1353 + 0.0000i


p =

 -55.0000 + 0.0000i
 -45.0000 + 0.0000i
  -3.5000 + 9.8869i
  -3.5000 - 9.8869i
  -3.0000 + 9.2736i
  -3.0000 - 9.2736i
   0.0000 + 0.0000i


k =

     []

F = -(0.0018)/(s+55) + (0.0066)/(s+45) + (0.9513+0.0896i)/(s+3.5-9.8869i) + (0.9513-0.0896i)/(s+3.5+9.8869i)
```

Problem 3. Use MATLAB and the SYMBOLIC MATH TOOLBOX to find the Laplace Transform of the following functions (1) f(t)=8t^2cos (3t+45°) (2) f(t)=3te^-2tsin (4t+60°)

```
%(1)
syms t % Construct symbolic object for frequency variable "t'
f = 8*t^2*cosd(3*t+45)
F = laplace(f) % Find Laplace transform
%pretty(F) %Pretty Print Laplace
```

```
f =

8*t^2*cos((pi*(3*t + 45))/180)


F =

4*2^(1/2)*(pi/(30*(pi^2/3600 + s^2)^2) - (2*s^2*pi)/(15*(pi^2/3600 + s^2)^3)) - 4*2^(1/2)*
((6*s)/(pi^2/3600 + s^2)^2 - (8*s^3)/(pi^2/3600 + s^2)^3)
```

```
%(2)
syms t % Construct symbolic object for frequency variable 't'
f = 3*t*exp(-2*t)*cosd(3*t+45)
F = laplace(f) % Find Laplace transform
%pretty(F) %Pretty Print Laplace
```

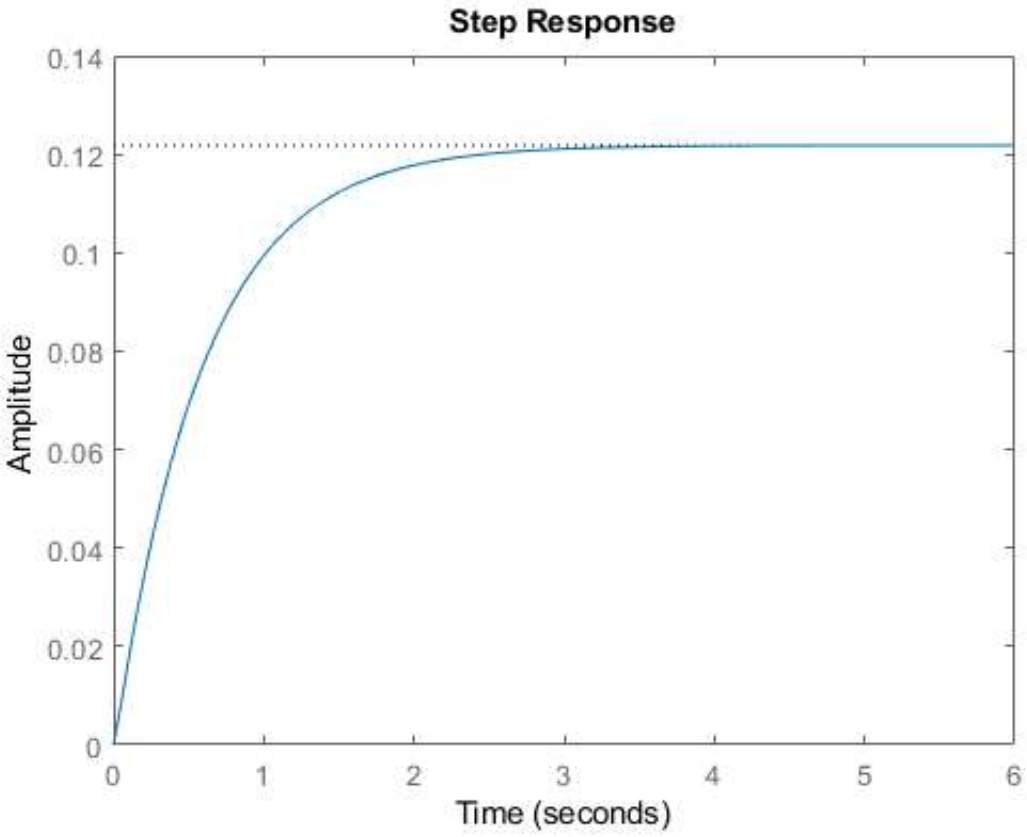
```
f =

3*t*cos((pi*(3*t + 45))/180)*exp(-2*t)


F =

- (3*2^(1/2)*(1/((s + 2)^2 + pi^2/3600) - ((2*s + 4)*(s + 2))/((s + 2)^2 + pi^2/3600)^2))/
2 - (2^(1/2)*pi*(2*s + 4))/(40*((s + 2)^2 + pi^2/3600)^2)
```

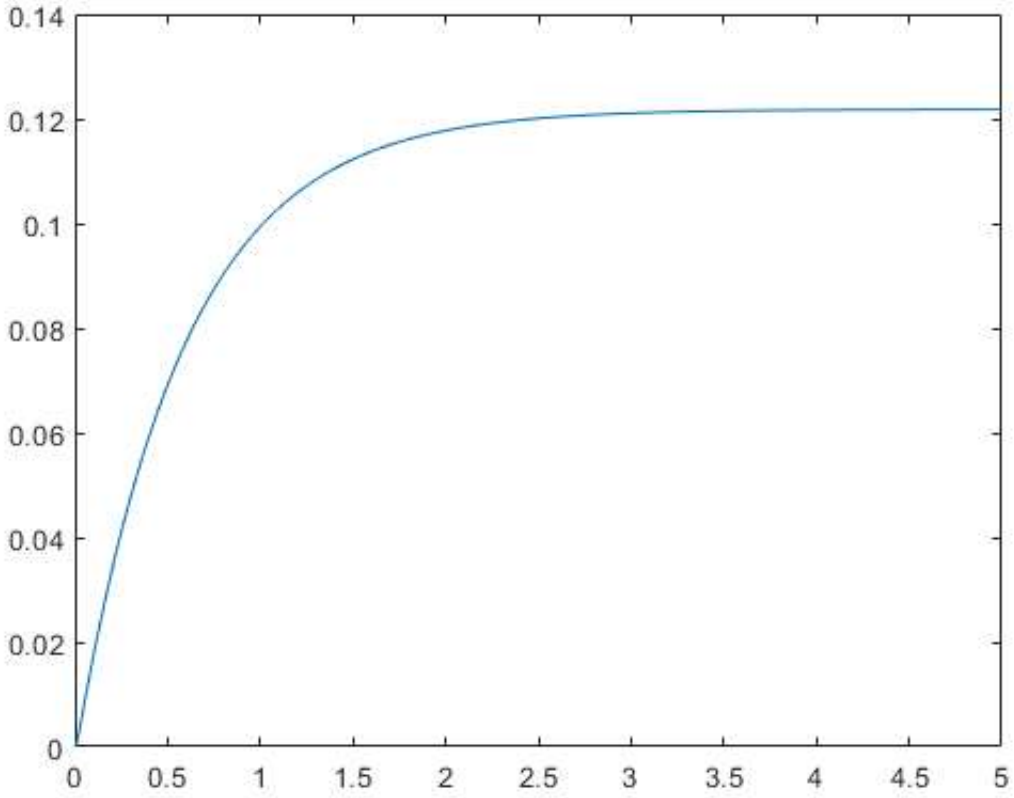
Problem 4. Using MATLAB find and plot the angular velocity response to a unit step input

```
syms s % Construct symbolic object for frequency variable 's'
f = (20.83)/((s+100)*(s+1.71))
F = ilaplace(f) % Find Laplace transform
%With step input
w = (20.83)/(s*(s+100)*(s+1.71))
W = ilaplace(w) % Find Laplace transform

%Using Sys Transfer Function And Step Input
sys = tf([20.83],poly([-100 -1.71]))
step(sys,6);
%Using Solution From Inverse Laplace Transform
figure(2);
```

```
x = [0:0.01:5];
check = (2083*exp(-100*x))/982900 - (208300*exp(-(171*x)/100))/1680759 + 2083/17100;
plot(x,check)
```

```
f =

2083/(100*(s + 100)*(s + 171/100))


F =

(2083*exp(-(171*t)/100))/9829 - (2083*exp(-100*t))/9829


w =

2083/(100*s*(s + 100)*(s + 171/100))


W =

(2083*exp(-100*t))/982900 - (208300*exp(-(171*t)/100))/1680759 + 2083/17100


sys =

         20.83
  -------------------
  s^2 + 101.7 s + 171

Continuous-time transfer function.
```


Step Response
Amplitude
Time (seconds)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
1
2
3
4
5
6


0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

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