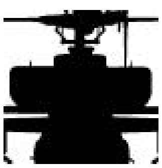
OKLAHOMA STATE UNIVERSITY

SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING



ECEN 3413 Controls I
Spring 1998
Design Project

Name : ______________________________

Student ID: ________________________________

E-Mail Address:_______________________________________

1) Write matlab script files and plot the functions below:

a) $3e^{-2t}u(t)$

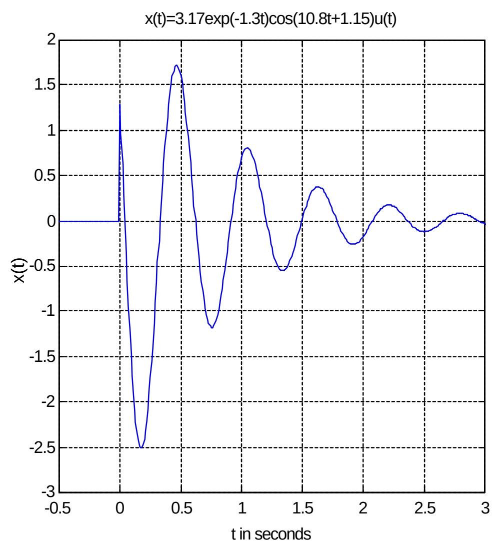
b) $2[1-e^{-1.8t}]u(t)$

c) $e^{-1.8t}\cos(8t+\pi/5)\ u(t)$

d) $2e^{-1.8t}\sin(10t- \pi /4)\ u(t)$

Example: $3.17e^{-1.3t}\cos(10t + 1.15)\ u(t)$

```
% example: plot function  3.17exp(-1.3t)cos(10.8t+1.15)u(t)
ts=-0.5;  % start time
tf=4;     % final time
dt=0.01;  % time increment
tzro=0;   % time that step become 1
t = ts:dt:tf; % time => -start:increment:stop
points_of_u = size(t);  %
u = zeros(points_of_u);
u((tzro-ts)/dt+1 : (tf-ts)/dt+1) = ...
                                 ones(size(t((tzro-ts)/dt+1 : (tf-ts)/dt+1)));
x = 3.17*exp(-1.3*t).*cos(10.8*t+1.15).*u;
   % calculate x(t)=3.17exp(-1.3t)cos(10.8t+1.15)u(t)
plot(t,x);
axis([-0.5, 3, -3, 2]);
title('x(t)=3.17exp(-1.3t)cos(10.8t+1.15)u(t)');
xlabel('t in seconds');
ylabel('x(t)');
grid;
```



2) Write Matlab script files and plot step response and impulse response of LTI systems below:

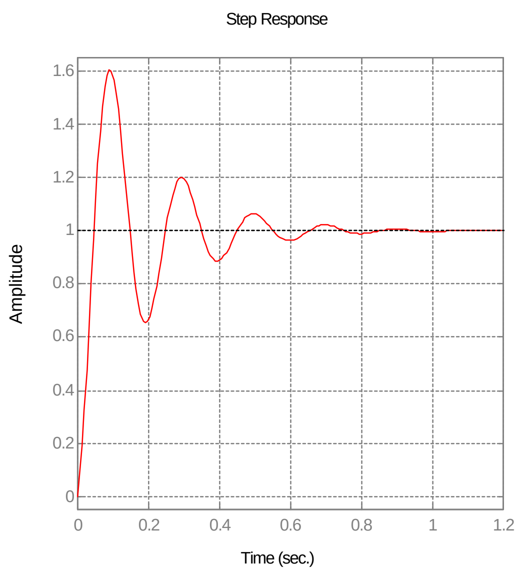
a) b)

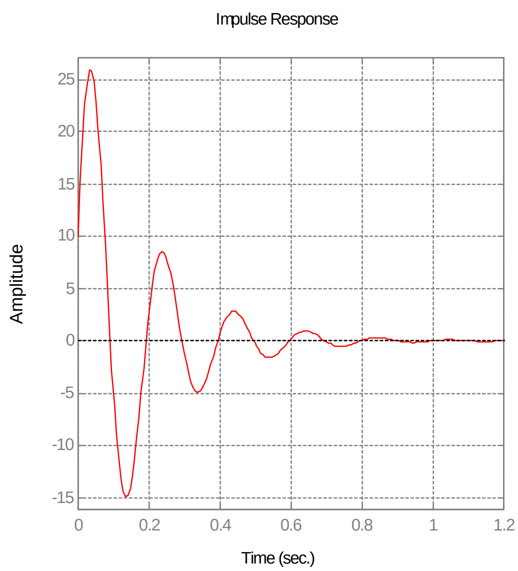
c) d)

Example:

$$H(s) = \frac{R_2C\ S + 1}{LC\ S^2 + C(R_1 + R_2)\ S + 1}$$

```
% set parameter
R1=1;
R2=10;
C=0.001;
L=1;
num=[R2*C, 1];  % numerator of H(S)
den=[L*C, C*(R1+R2), 1]; % denominator of H(S)
% we specify this plant as an LIT model with transfer function
%    H(S). This is done with the function TF:
H = tf(num,den);
% the step response of LTI model is found
%    by using the STEP command:
figure(1);
step(H);
grid;
% the impulse response of LTI model is found
%   by using the IMPULSE command:
figure(2);
impulse(H);
grid;
```





3) Find the inverse transforms of the equations below. (Hint: use a matlab command, RESIDUE, to compute Partial Fraction Expansion (PFE)):

a) $$Y(z) = \frac{6z^2 - 10z + 2}{z^2 - 3z + 2}, \quad 1 < |z| < 2$$

b) $$Y(z) = \frac{0.1z^2}{(z - 0.9)(z - 0.8)(z - 1)}, \quad |z| > 1$$

c) $$Y(z) = \frac{z^4 - 2.9z^3 + 1.4z^2}{(z - 1)(z^4 - 0.3z^3 - 0.4z^2 - 0.5z + 0.6)}, \quad |z| > 1$$

d) $$Y(z) = \frac{z^5 - 3.3z^4 + 0.6z^3 + 2.2z^2 - 0.6}{(z - 1)(z^4 - 0.3z^3 - 0.4z^2 - 0.5z + 0.6)}, \quad |z| > 1$$

Example: $$Y(z) = \frac{0.6z^3 + 0.8z^2 - 0.4z}{(z^2 + 0.3z - 0.4)(z-1)}, \quad |z| > 1$$

```
% Compute PFE constants and poles of a rational fuction.
% numerator coefficients of Y(a)/z
b=[0.6, 0.8, -0.4];

% denominator coefficients of Y(z)/z
a=conv([1, 0.3, -0.4],[1, -1]);
     % CONV: convolves the 2 vectors of polynomial coefficients,
      % convolving them is equivalent to multiplying
      % the two polynomials.
[PFE, poles]=residue(b,a)      % call residue
     % PFE=partial fraction expansion, poles=poles of the fractions
```

PFE =

```
    1.1111
   -0.28034
   -0.23077
```

poles =

```
      1
    -0.8
     0.5
```

So we get :

$$Y(z) = \frac{-0.280z}{z + 0.8} - \frac{0.231z}{z - 0.50} + \frac{1.111z}{z - 1}$$

and the solution

$$y(n) = [-0.280(-0.80)^n - 0.231$$