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HW 2

```
% Start off fresh
clear all;
clc;
```

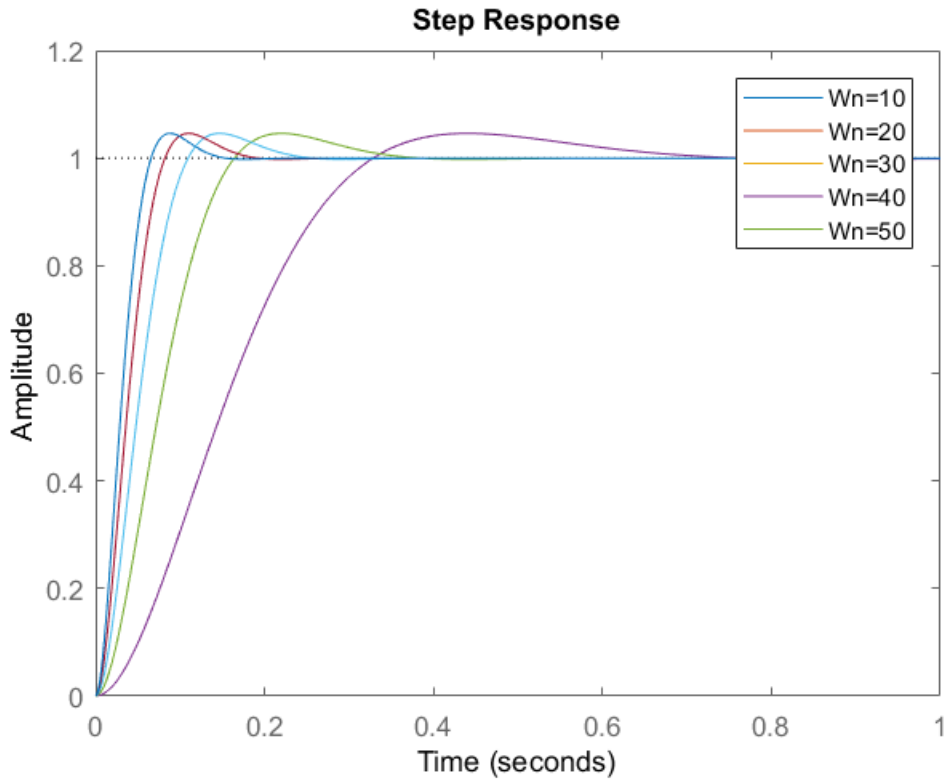
Question 1

set Z = 0.7 and vary Wn from 10 to 50 to see how the specifications vary

```
Z= 0.7;

for i = 10:10:50
% Vary value of Wn
    Wn = i;
% Now create the transfer function based on variables above
% Divide by 10 to index 1-5
    H(i/10) = tf(Wn.^2, [1 2*Z*Wn Wn.^2]);
end

% And finally plot step response for each Wn
figure(1);
step(H(1),H(2),H(3),H(4),H(5))
legend('Wn=10','Wn=20','Wn=30','Wn=40','Wn=50');
hold on;

% The step response info for Wn=10 and Wn=50
disp(stepinfo(H(1)));
disp(stepinfo(H(5)));

% Wn seems to only affect the timing of the system.  A higher Wn
 results in
% a faster rise time, settle time, and peak time.  All other
 parameters
% remained constant
```

```
        RiseTime: 0.2127
    SettlingTime: 0.5979
     SettlingMin: 0.9001
```

```
    SettlingMax: 1.0460
      Overshoot: 4.5986
     Undershoot: 0
           Peak: 1.0460
       PeakTime: 0.4408

       RiseTime: 0.0425
    SettlingTime: 0.1196
     SettlingMin: 0.9001
     SettlingMax: 1.0460
      Overshoot: 4.5986
     Undershoot: 0
           Peak: 1.0460
       PeakTime: 0.0882
```



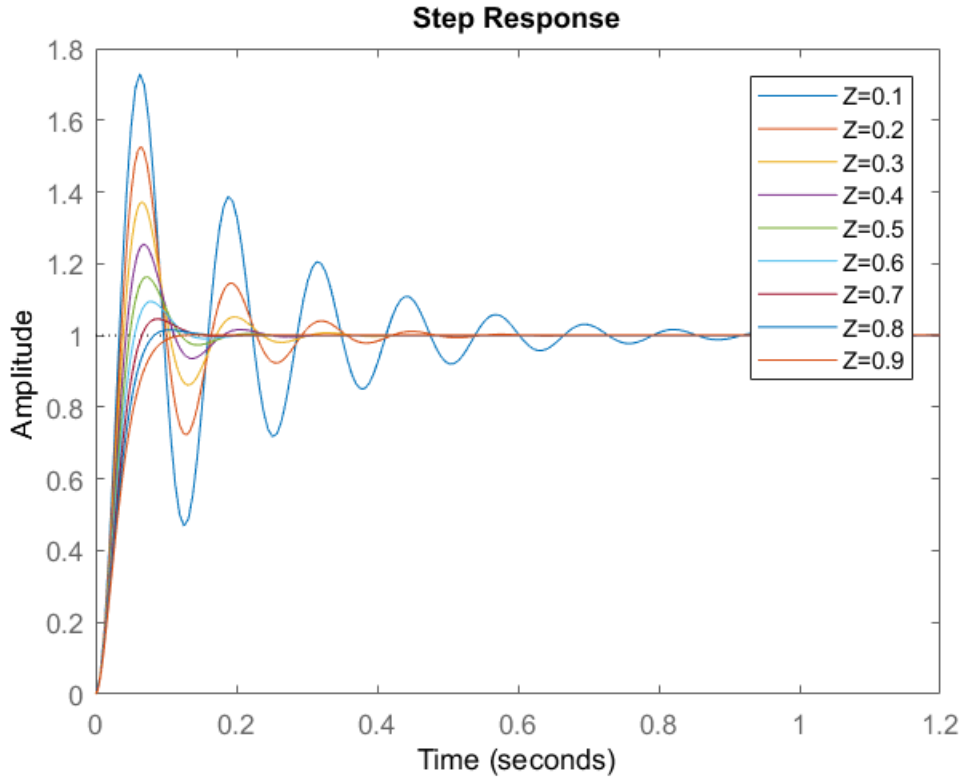
Question 2

set Wn=50 and vary Z from 0.1 to 0.9

```
Wn = 50;

for i = 1:1:9  % integer values required
% Divide to get proper Z value
    Z = i/10;
% Calculate the transfer function
```

```
    H(i) = tf(Wn.^2, [1 2*Z*Wn Wn.^2]);
end
% And finally plot step response for each Z
figure(2);
step(H(1),H(2),H(3),H(4),H(5),H(6),H(7),H(8),H(9))
legend('Z=0.1','Z=0.2','Z=0.3','Z=0.4','Z=0.5','Z=0.6','Z=0.7','Z=0.8','Z=0.9')

% The step response info for Z=0.1,0.5, and 0.9
disp(stepinfo(H(1)));
disp(stepinfo(H(5)));
disp(stepinfo(H(9)));

% Varying Z changes all but the undershoot parameter.  Increasing the
 value
% of Z results in less overshoot and a shorter settling time but
 increases
% the rise time of the system
```

```
        RiseTime: 0.0225
    SettlingTime: 0.7675
     SettlingMin: 0.4685
     SettlingMax: 1.7292
       Overshoot: 72.9156
      Undershoot: 0
            Peak: 1.7292
        PeakTime: 0.0628

        RiseTime: 0.0328
    SettlingTime: 0.1615
     SettlingMin: 0.9315
     SettlingMax: 1.1629
       Overshoot: 16.2929
      Undershoot: 0
            Peak: 1.1629
        PeakTime: 0.0718

        RiseTime: 0.0577
    SettlingTime: 0.0940
     SettlingMin: 0.9024
     SettlingMax: 1.0015
       Overshoot: 0.1524
      Undershoot: 0
            Peak: 1.0015
        PeakTime: 0.1443
```



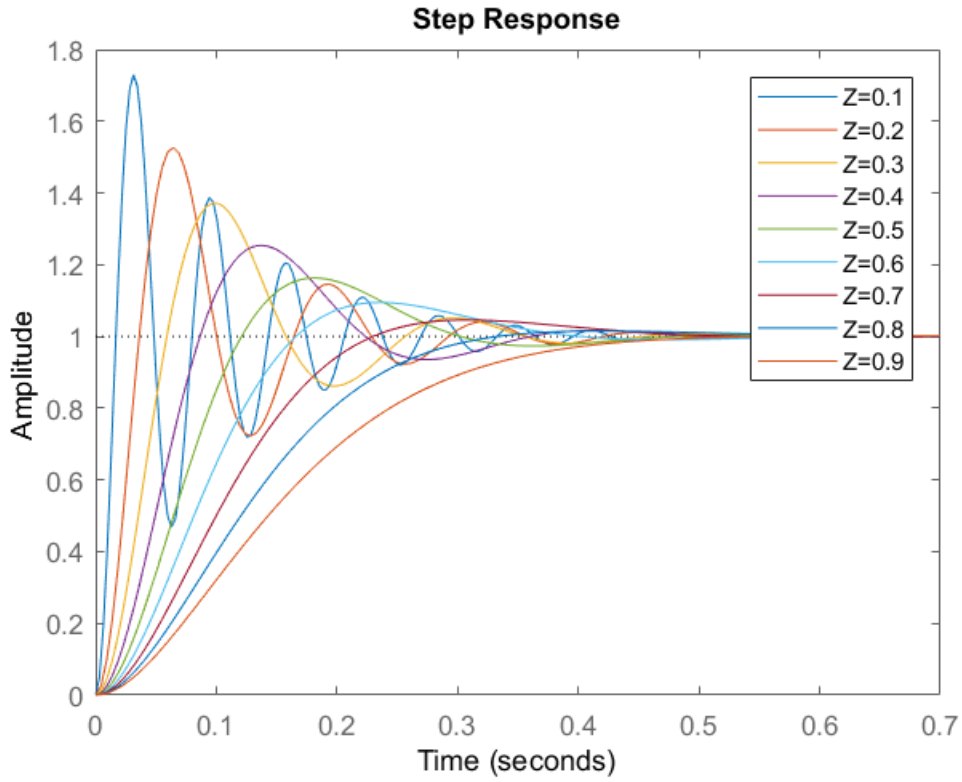
Question 3

vary Z from 0.1 to 0.9 and keep Z*Wn = 10 for each case

```
for i = 1:1:9  % integer values required
% Divide
    Z = i/10;
    Wn = 10/Z;
    H(i) = tf(Wn.^2, [1 2*Z*Wn Wn.^2]);
end
figure(32);
step(H(1),H(2),H(3),H(4),H(5),H(6),H(7),H(8),H(9))
legend('Z=0.1','Z=0.2','Z=0.3','Z=0.4','Z=0.5','Z=0.6','Z=0.7','Z=0.8','Z=0.9')

% The step response info for Z=0.1,0.5, and 0.9
disp(stepinfo(H(1)));
disp(stepinfo(H(5)));
disp(stepinfo(H(9)));
```

```
        RiseTime: 0.0113
    SettlingTime: 0.3837
     SettlingMin: 0.4685
     SettlingMax: 1.7292
       Overshoot: 72.9156
      Undershoot: 0
            Peak: 1.7292
```

```
    PeakTime: 0.0314

    RiseTime: 0.0820
SettlingTime: 0.4038
 SettlingMin: 0.9315
 SettlingMax: 1.1629
   Overshoot: 16.2929
  Undershoot: 0
        Peak: 1.1629
    PeakTime: 0.1796

    RiseTime: 0.2595
SettlingTime: 0.4230
 SettlingMin: 0.9024
 SettlingMax: 1.0015
   Overshoot: 0.1524
  Undershoot: 0
        Peak: 1.0015
    PeakTime: 0.6493
```



Question 4

compare calculations and approximations

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