MATLAB Exercise

1. We can use MATLAB to calculate characteristics of a second order system, such as damping ratio, ζ; natural frequency, ω_n; percent overshoot, %OS (pos); settling time, T_s; and peak time, T_p. Observe the MATLAB code below for the calculation of above parameters for the following pole-zero plot.

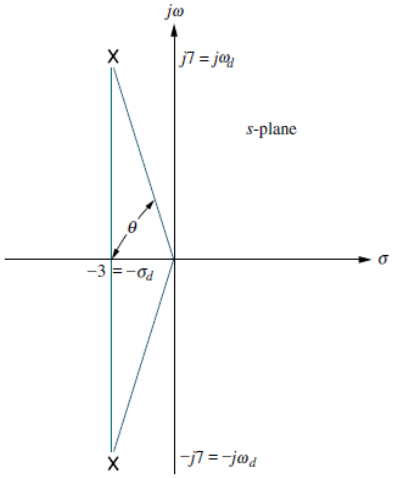


Figure M1: Pole-zero plot for M1

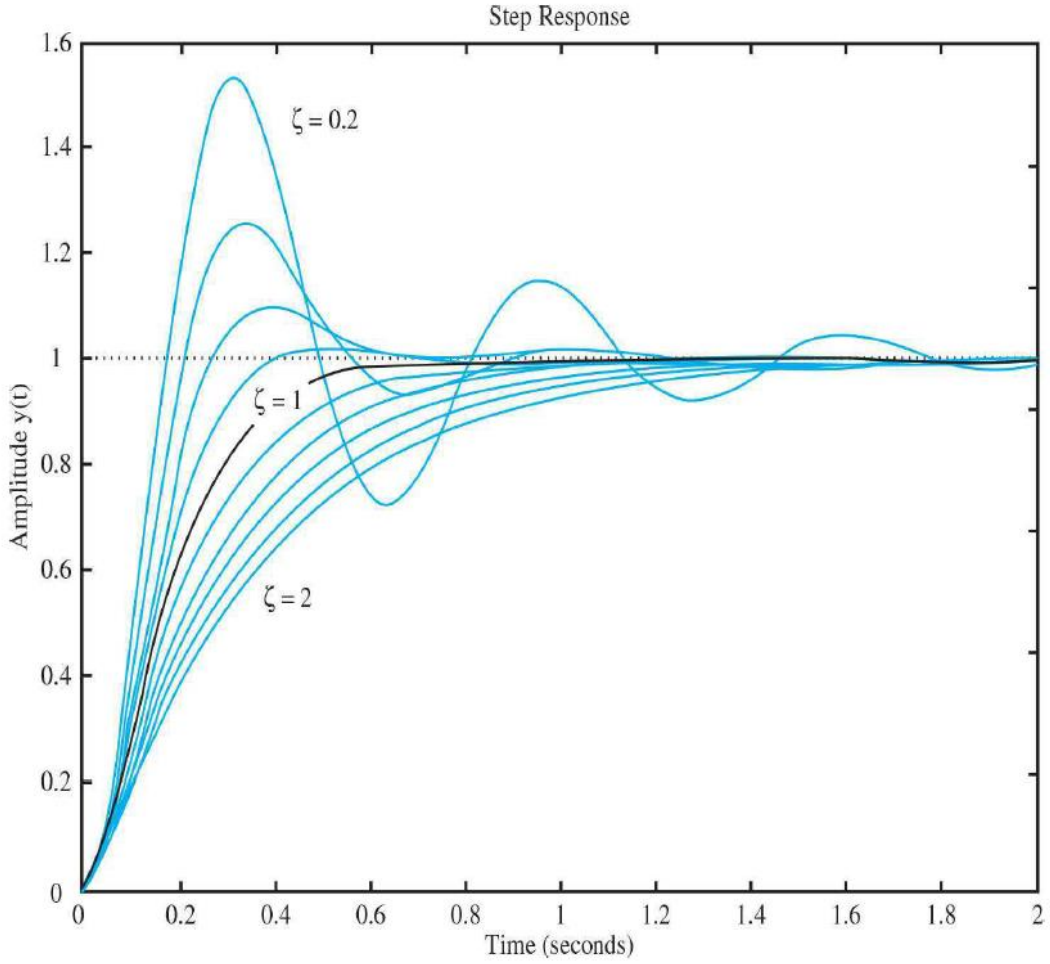
```
p1=[1 3+7*i];                    % Define polynomial containing first pole.
p2=[1 3-7*i];                    % Define polynomial containing second pole.
den=conv(p1 ,p2);                % Multiply the two polynomials to find the 2nd order
                                 % polynomial, as^2+bs+c.
omegan=sqrt (den (3) /den (1))   % Calculate the natural frequency, sqrt(c/a).
zeta=(den(2)/den(1))/(2*omegan)  % Calculate damping ratio, ((b/a)/2*wn).
Ts=4/(zeta*omegan)               % Calculate settling time, (4/z*wn).
Tp=pi/(omegan*sqrt(1-zeta^2))        % Calculate peak time, pi/wn*sqrt(l -z^2).
pos=100*exp( -zeta*pi/sqrt(1-zeta^2))  % Calculate percent overshoot (100*e^(-z*pi/sqrt(l-
                                 % z^2)).
```

- Use the above procedure to find ζ, ω_n, %OS, T_s and T_p for the following second order system.

$$G(s) = \frac{10}{3s^2 + 8s + 24}$$

- Use *tf* and *stepplot* or *step* functions to plot the step response, and compare with the results obtained before. Note: You may left click the mouse on the curve to get more information about a particular coordinate. Moreover, by right clicking away from the curve brings up a menu, from which you can obtain the characteristics of the step response curve by mouse pointing at the appearing dots.

2. For a 2nd order system, obtain the following response curves by changing ζ from 0.2 to 2.



3. For a 2nd order system, figure out what happens to %OS when ζ changes from 0 to 1 (slide #42). Plot the result.