Assignment 1

Smart throttle for EV's Project

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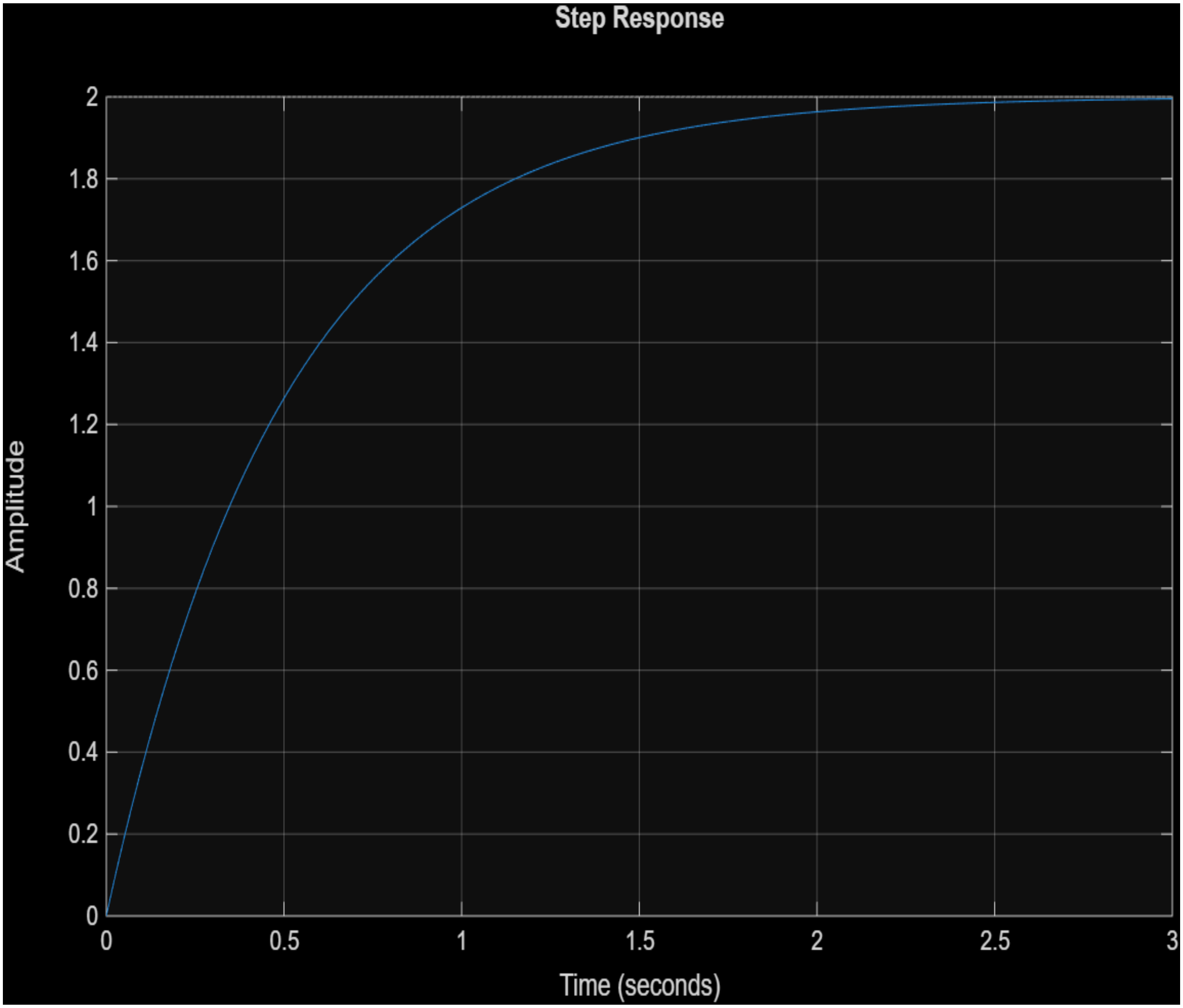
Q1 1



2 Time constant = 0.5 sec (2/(0.5s+1)

Rise Time = 2.2*time constant= 1.1 sec

Settling Time=4* T=2 sec

y_{ss} = 2

Error= -1

3 Curve flattens out at 2 on the y axis

Q2 1 1

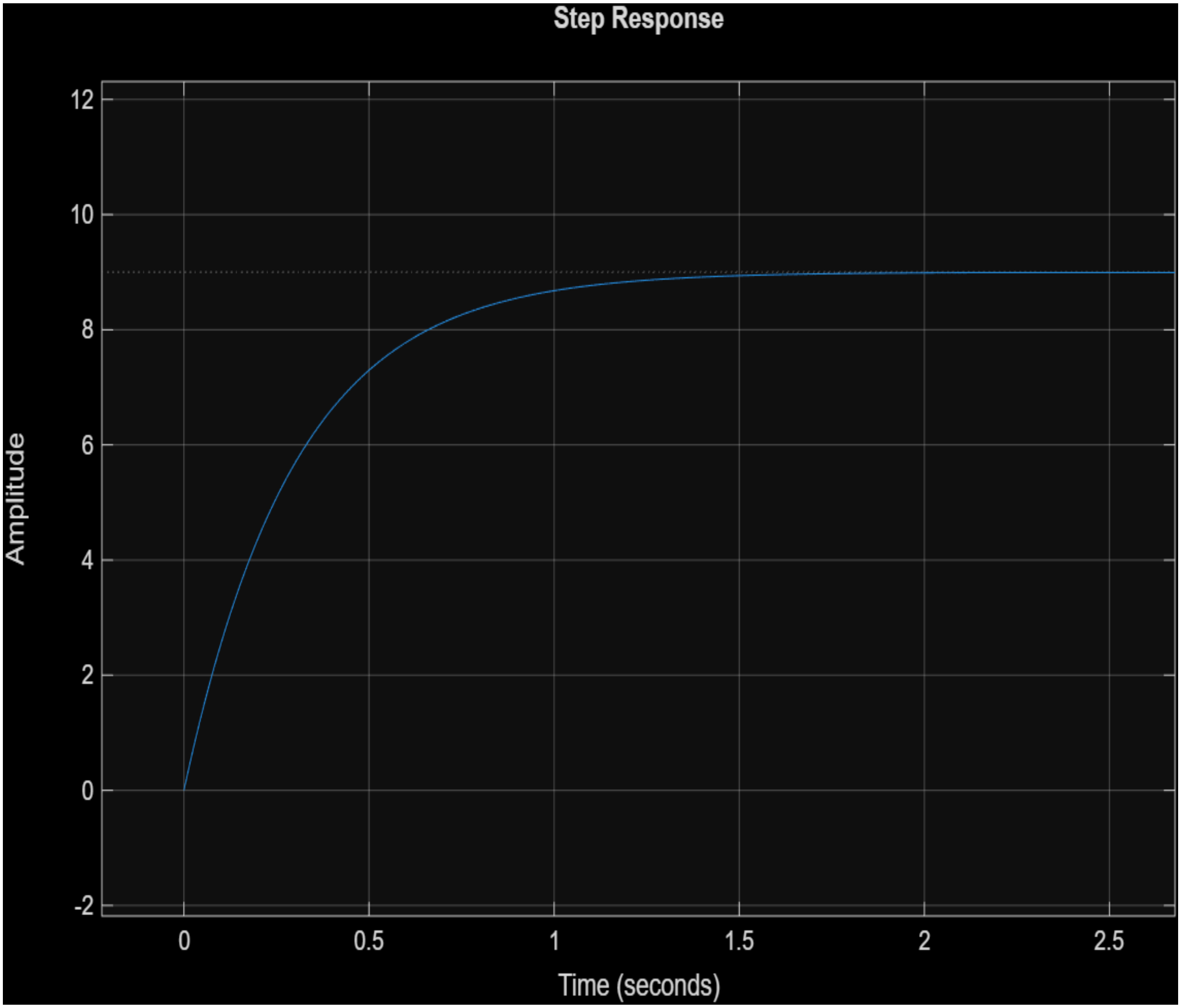
2 Infinity for open loop and 1 for closed loop.

3 It should overshoot 1 as when the step input is passed in the function the s^2 term is formed which corresponds to the linear increase of the output and thus it will overshoot.

Q3 1 a=3.33, K =9 (by solving the corresponding equations)

2 The K that we found in the error is the DC gain(G[0]) of the plant and the a is same as above. Therefore, K/3.33=9, K=29.97

3 The system should be faster than the Q1 as the time constant is 0.3s which is lesser than 0.5s and the output value is (1-0.1=0.9) thus it is lesser.



Q4 1 By solving the equation for T(s)=3K(s+z)/((1+3K)s+(1+3Kz)). Using the condition y_{ss}= 0.8 i.e. $\lim_{s\to 0}$T(s) this gives us Kz=4/3. The Damping ratio is greater than or equal to 0.6. Let z<2.67 and K >0.5 using t_s<2.

2 T(s)=3Ks+4/(s(1+3K)+5).

3 i] Increase. Adding a zero to the closed-loop transfer function generally increases the overshoot because it adds a derivative term to the response making it react faster.

ii] Increases as we can observe from the steady state output value(y_{ss}).

iii] The controller adds a zero (which speeds up rise time) and gain K (which increases bandwidth). Both factors contribute to a faster response time compared to the original plant.

Q5 1 System type is defined by number of integrators in the open loop system. Thus it is zero.

2 It will show infinite error.

3 We had y_{ss}=0.8 thus substituting it in the equation we get 0.2/s which will tend to infinity at s tends to infinity.

4 No as the ramp error requires an integrator for the error to fix and addition of zero does smoothen the transient state but it does not fix the infinity situation.