Part 1:

```
w=[0:0.1:500];    %Define range
H=1./(1+i*0.01*w);  %Dot before division allows us to apply a vector.
H_mag=abs(H);
H_angle=angle(H);

figure(1)
plot(w,H_mag)
grid
title('Magnitude')
xlabel('w')
ylabel('|H(jw)|')

figure(2)
plot(w,H_angle*180/pi) %Convert to degrees when plotting.
grid
title('Angle')
xlabel('w')
ylabel('<H(jw)')
```

1. $V_R + V_C = x(t)$ $\quad Ri(t) + \frac{1}{C}\int_{-\infty}^{t} i(\tau)d\tau = x(t)$ $\quad Ri(t) + \frac{1}{CD}i(t) = x(t)$

$RDi(t) + \frac{i(t)}{C} = Dx(t)$ $\quad \left(RD + \frac{1}{C}\right)i(t) = Dx(t)$ $\quad i(t) = CDy(t)$

$\left(RD + \frac{1}{C}\right)\left(CDy(t)\right) = Dx(t)$ $\quad (RCD^2 + D)y(t) = Dx(t)$ $\quad (RCD + 1)y(t) = x(t)$

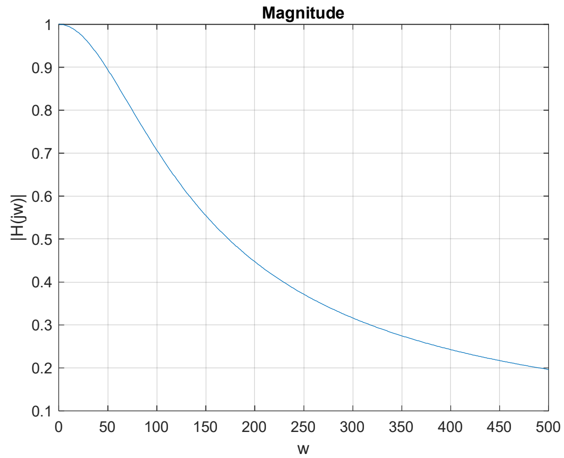
$RC\frac{dy(t)}{dt} + y(t) = x(t)$ $\quad RC\left(sY(s) - y(0)\right) + Y(s) = X(s)$ $\quad$ Let $y(0)$ be 0.

$RCsY(s) + Y(s) = X(s)$ $\quad (RCs + 1)Y(s) = X(s)$ $\quad H(s) = \frac{Y(s)}{X(s)} = \frac{1}{RCs+1}$

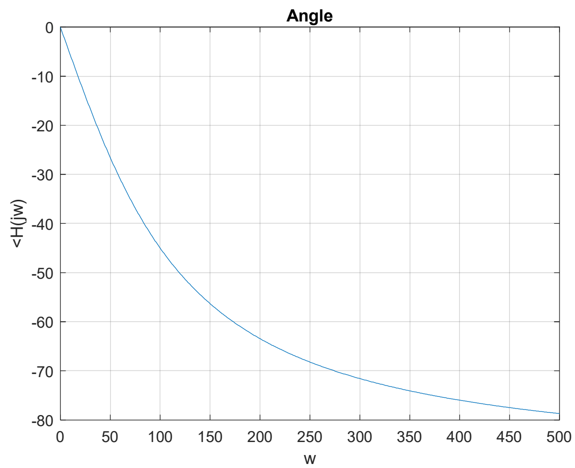
$H(j\omega) = \frac{1}{jRC\omega+1} = \frac{1}{j(10000)(10^{-6})\omega+1} = \frac{1}{j0.01\omega+1}$ $\quad |H(j\omega)| = \frac{100}{\sqrt{\omega^2+10000}}$

$\angle H(j\omega) = -\tan^{-1}(0.01\omega)$

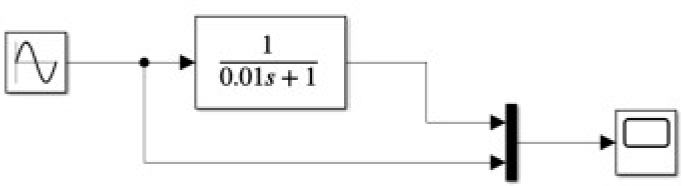
Magnitude:



Angle:



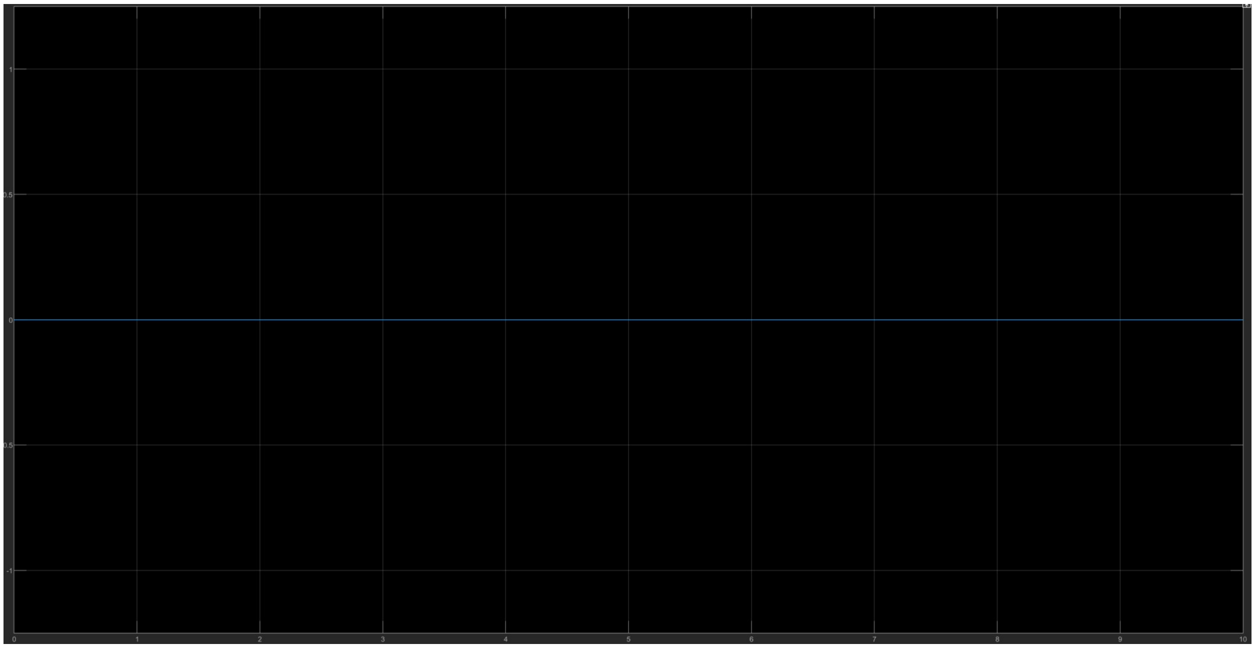
2.



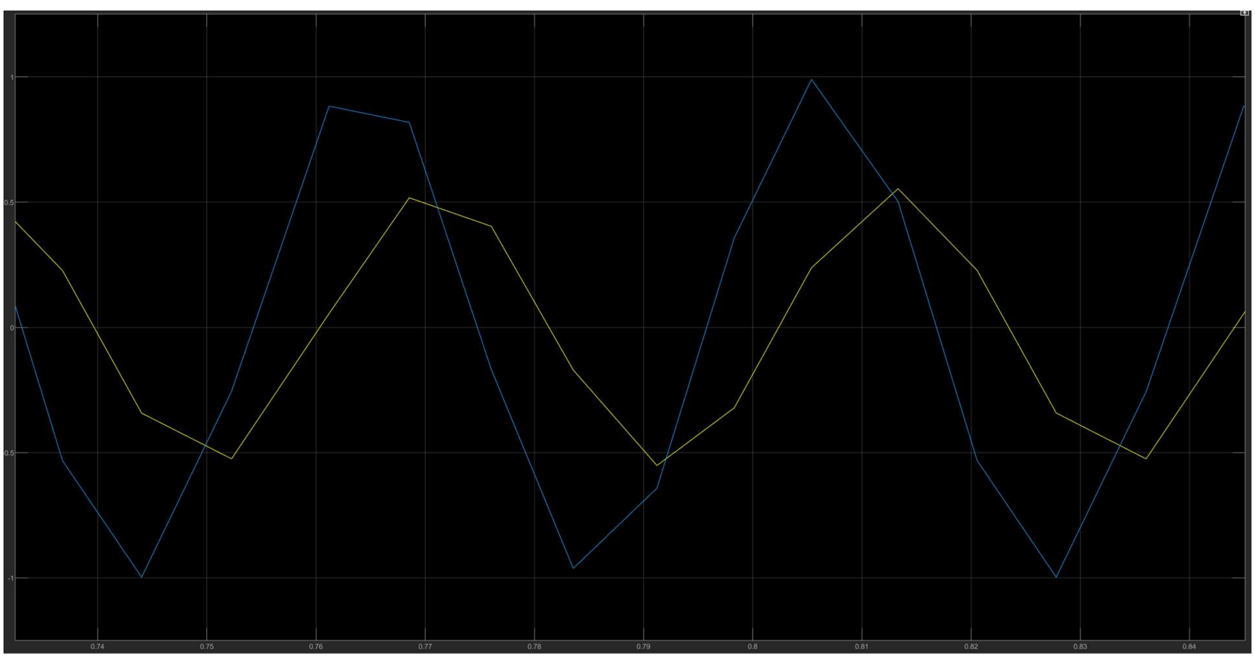
Input Frequency (ω rad/s)	$\lvert H(j\omega)\rvert$ (V)	$\angle H(j\omega)$ (Degrees)
0	0	0
150	0.5518	68.7549
300	0.3042	85.9437
400	0.2357	91.6732
500	0.1907	114.592

3.

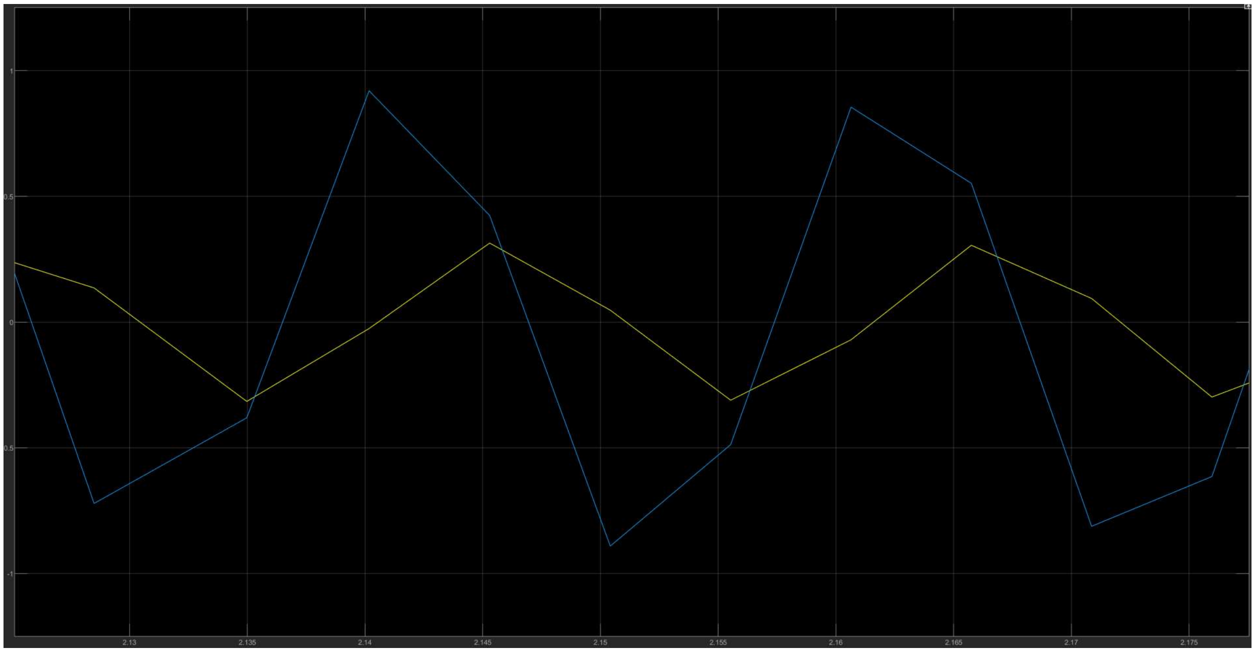
$\omega = 0$:



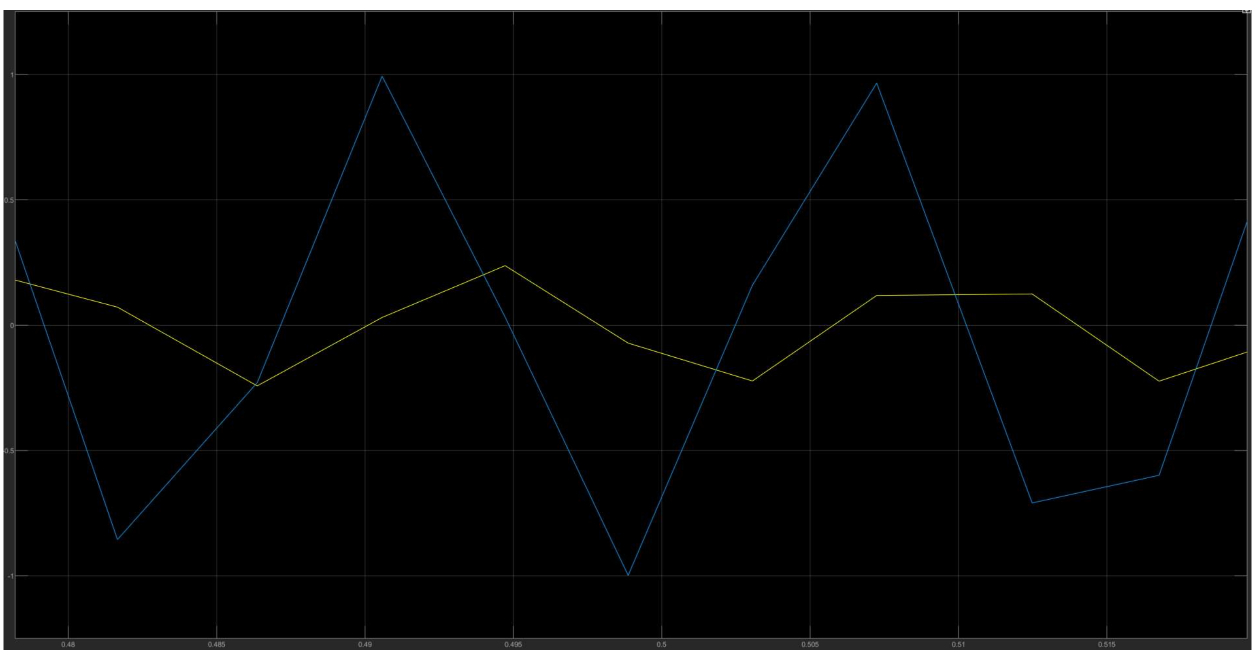
$\omega = 150$:



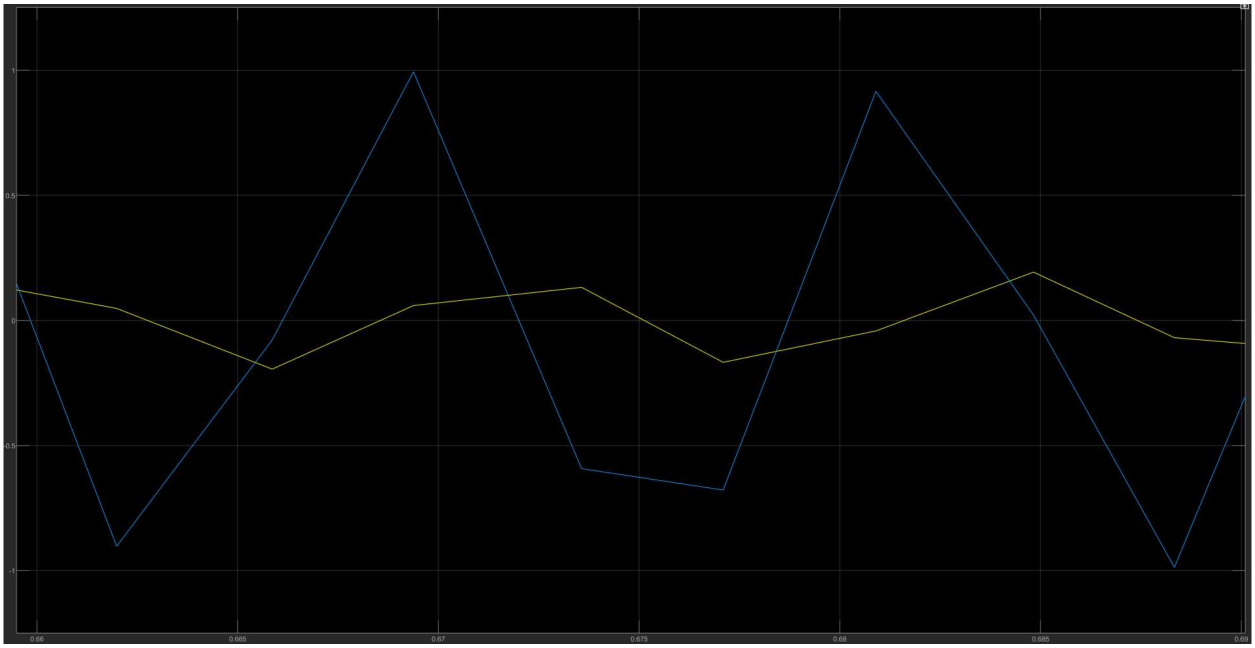
$\omega = 300$:



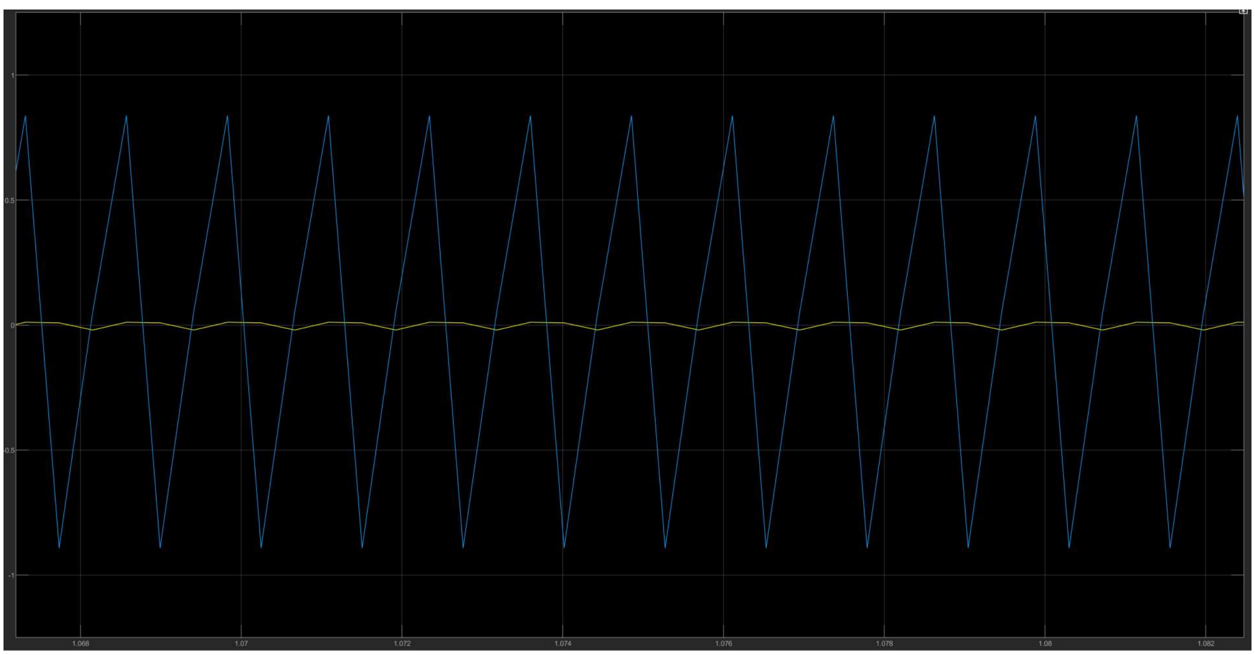
$\omega = 400$:



$\omega = 500$:



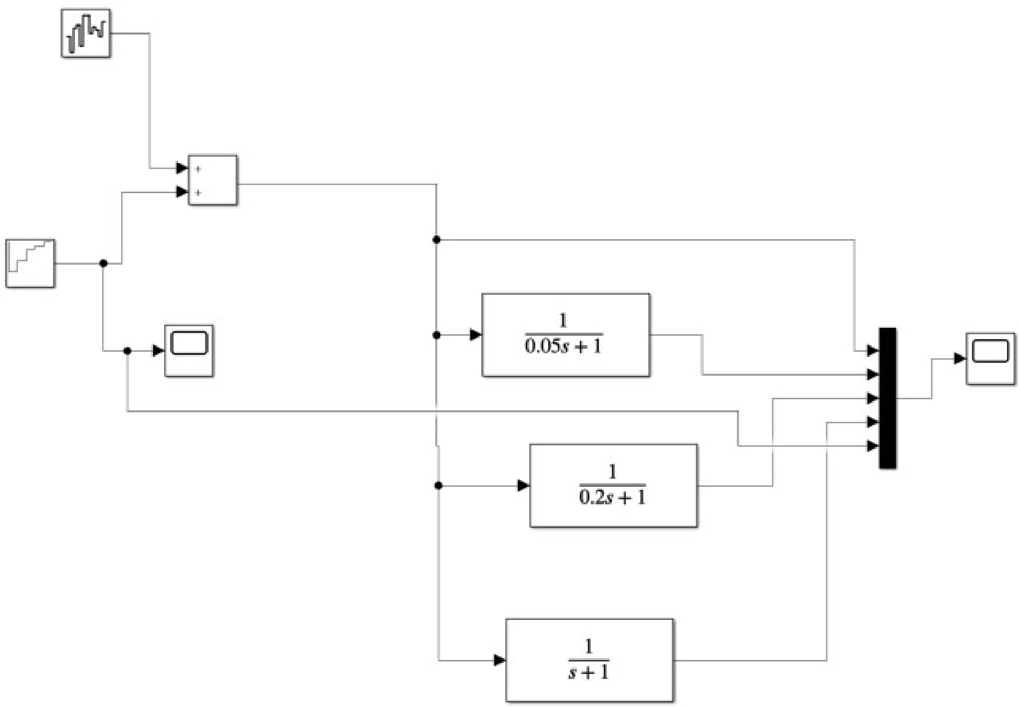
4.



At high frequency, the input signal is much larger in magnitude than the output signal. As such, the system appears to block such input, thus being a low-pass filter due to only having measurable output with lower input frequencies.

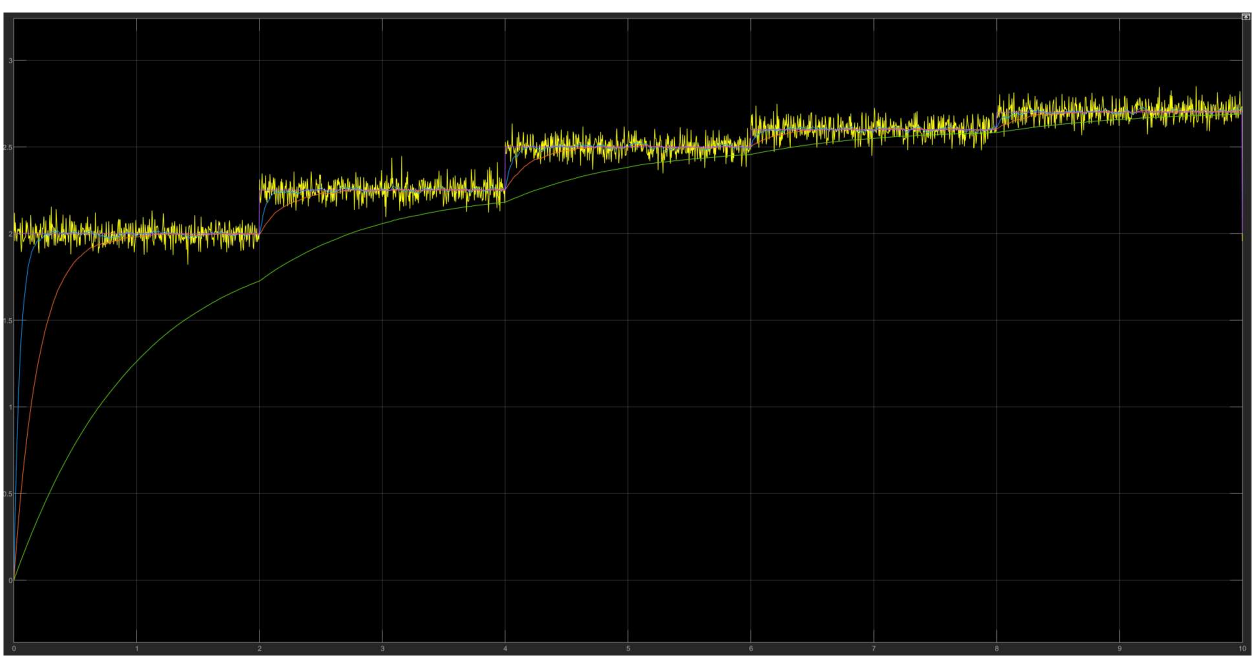
Part 2:

a.

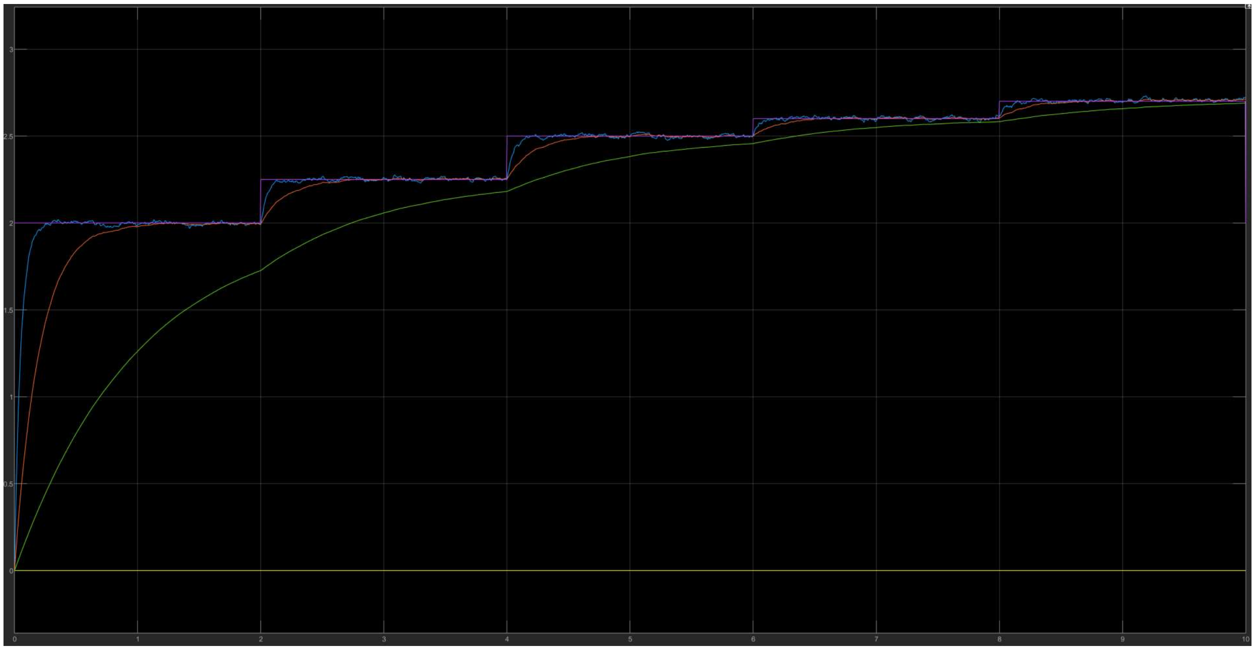


b.

With $n(t)$:



Without $n(t)$:



c. Despite the residual noise, the model with $\tau = 0.05$ (Blue line) captures the actual signal $x(t)$ the most accurately. This is because the other two models transition values too late to accurately resemble the intended value of $x(t)$ each time it changes values.