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Learning Report – Automotive Systems and Overview

Course Code: <CODE>



Version Number:

Team Members :

Team No:

Module: Model Based System Engineering

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**Document History**

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**DESIGN AND IMPLEMENTION…………………………………………………………………………………………………………………………………..**

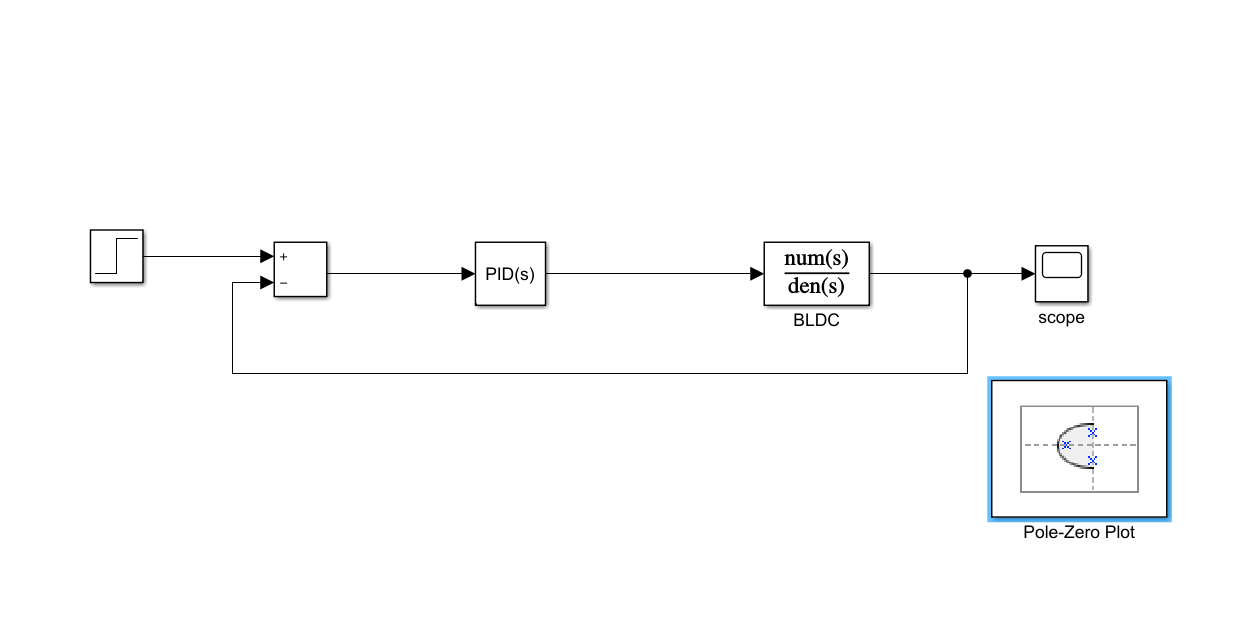
**TEST PLAN**

**MOTOR CONTROL ANALYSIS**

Introduction:

Here we have taken 4 systems to analyze they are BLDC with PID controller, PMSM with PID controller, Induction motor with PID controller and PMSM with PWM controller.

1-Brushless DC Motor with PID Controller:

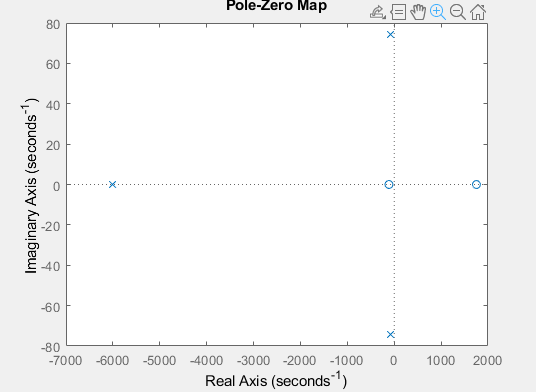


In this system, we will be analyzing the poles and zeros of the system when the PID controller is added to the system.

* We got 1 pair of complex conjugate pole, 1 pole pair on the horizontal axis and 2 zeroes.
* We got 3 poles and 2 zeroes on the left side of the imaginary axis

So, 2 zeroes and 2 poles will nullify their effect and 1 pole will be on the left side so that we can say that system is stable.

Pole-Zero Map and Analysis:



Poles of BLDC system:

1.0e+03 \*

-6.0172 + 0.0000i

-0.0882 + 0.0744i

-0.0882 - 0.0744i

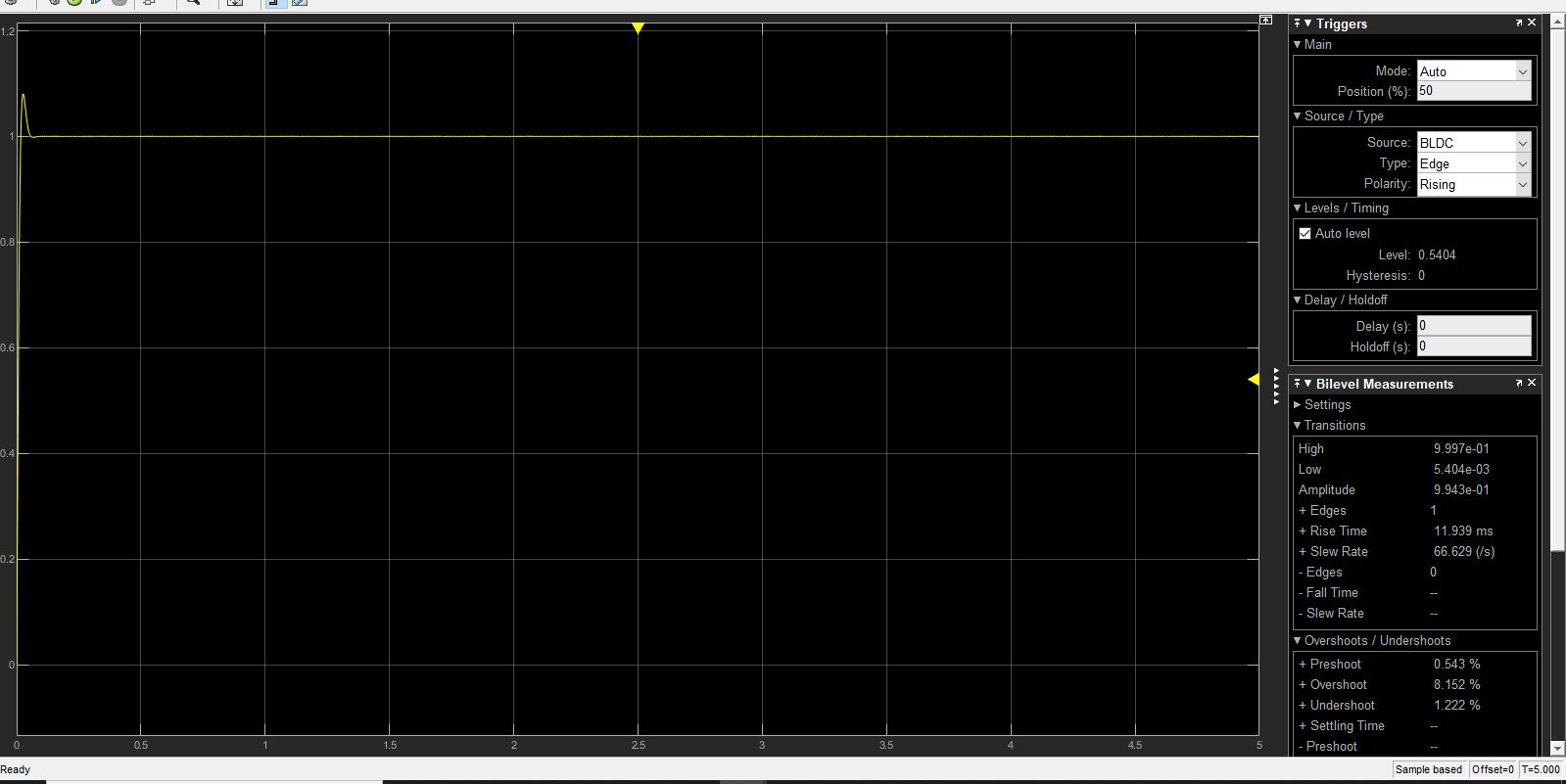
Zeroes of BLDC system:

1.0e+03 \*

1.7536

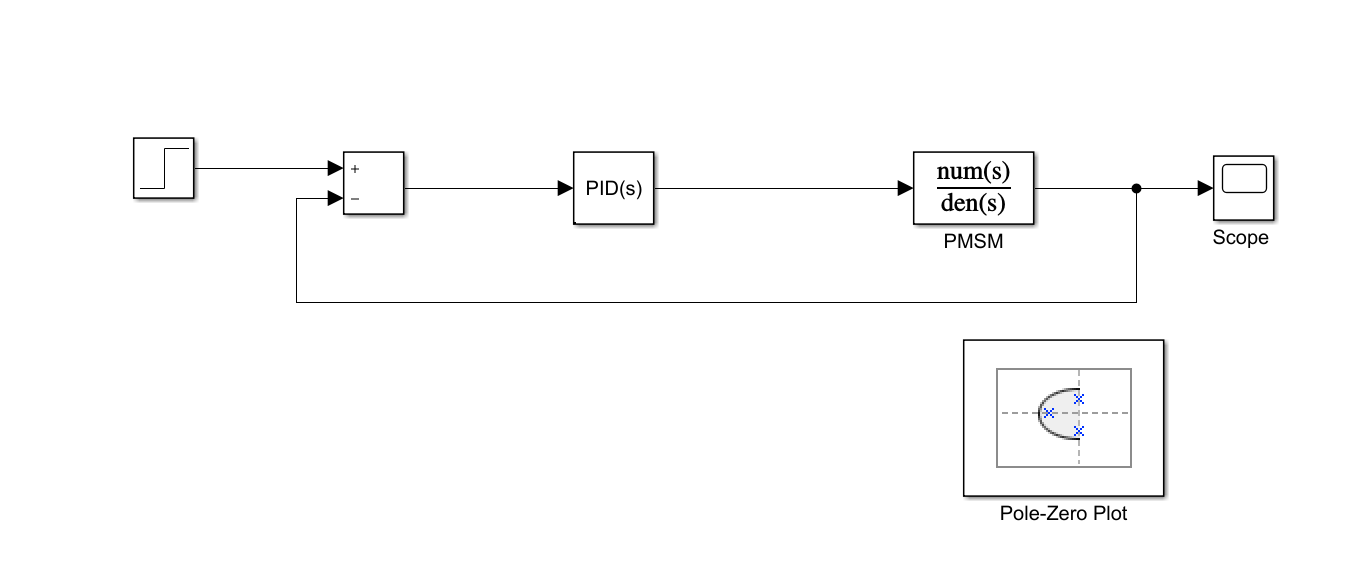
-0.1128

Output Graph:



After PID tuning we got the rise time as 11.9ms and overshoot is 8.152% as the tuning made the system parameters to adjust accordingly to get the stable system.

2- Permanent Magnet Synchronous Motor with PID Controller:

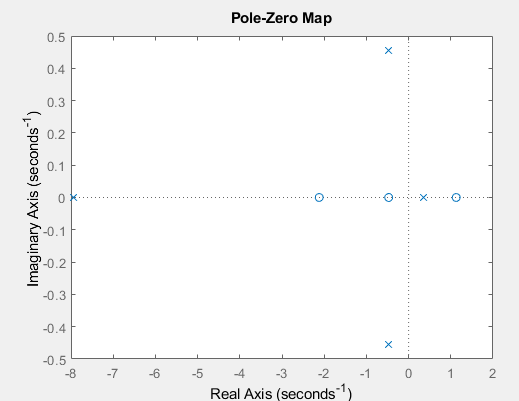


In this system, we will be analyzing the poles and zeros of the system when the PID controller is added to the system.

* We got 1 pair of complex conjugate pole, 1 pole pair on the horizontal axis and 3 zeroes.
* We got 3 poles and 2 zeroes on the left side of the imaginary axis and 1 pole and 1 zero on right side of the plane.

So, 2 zeroes and 2 poles will nullify their effect and 1 pole will be on the left side so that we can say that system is stable.

Pole-Zero map and Analysis:



Poles of PMSM system:

-7.9492 + 0.0000i

-0.4733 + 0.4552i

-0.4733 - 0.4552i

0.3446 + 0.0000i

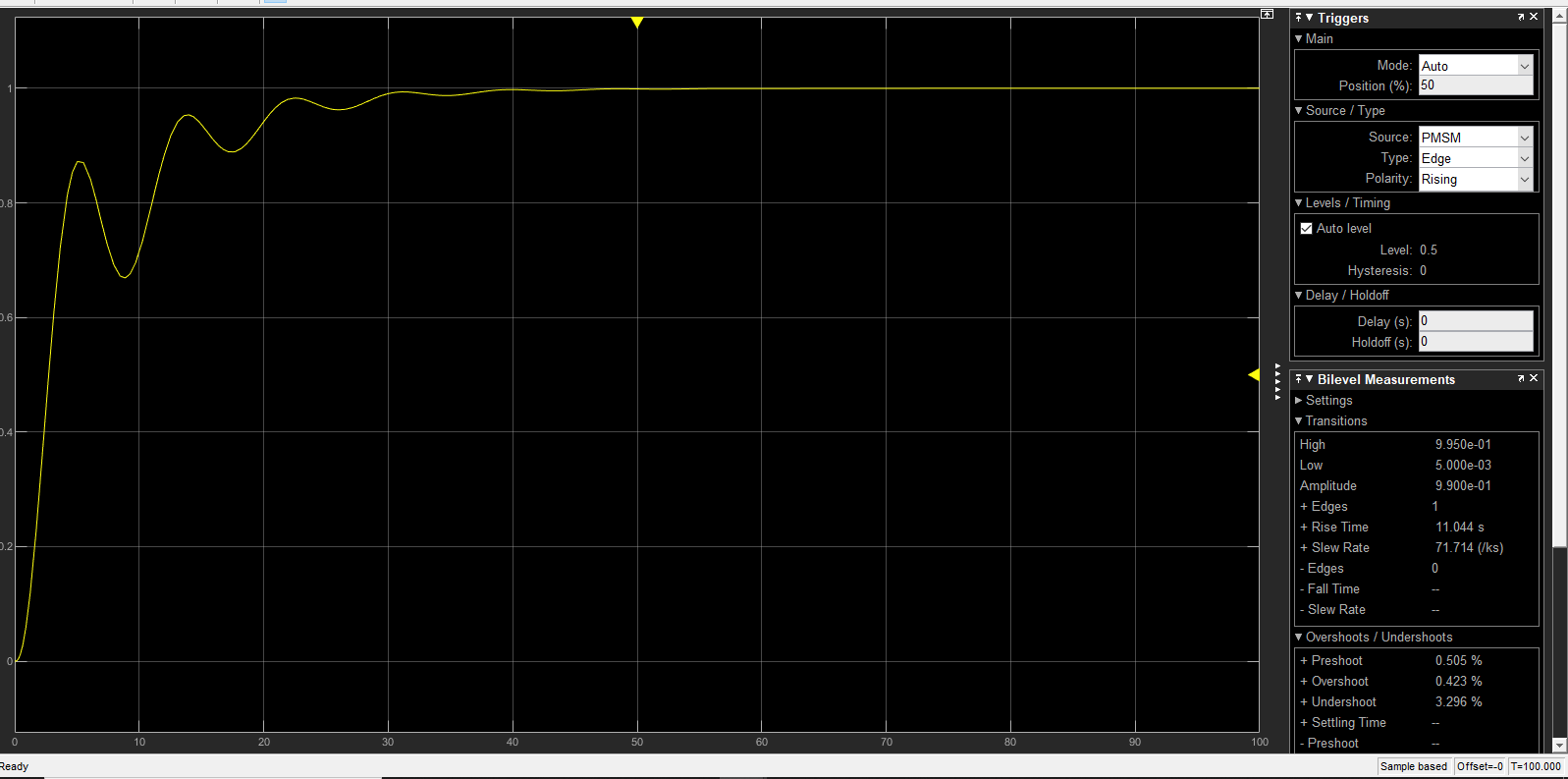
Zeroes of PMSM system:

-2.1189

1.1288

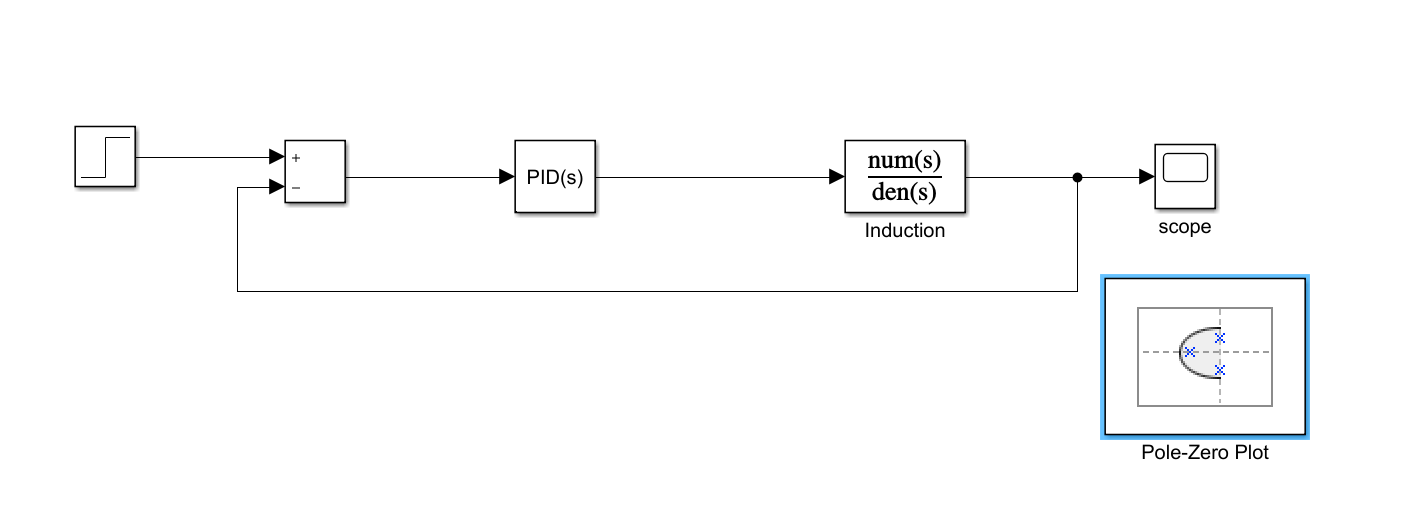
-0.4716

Output Graph:



After PID tuning we got the rise time as 11.044ms and overshoot is 0.423% as the tuning made the system parameters to adjust accordingly to get the stable system.

3-Induction Motor with PID Controller:



In this system, we will be analyzing the poles and zeros of the system when the PID controller is added to the system.

* We got 1 pair of complex conjugate pole, 1 pole pair on the horizontal axis and 2 zeroes.
* We got 3 poles and 2 zeroes on the left side of the imaginary axis

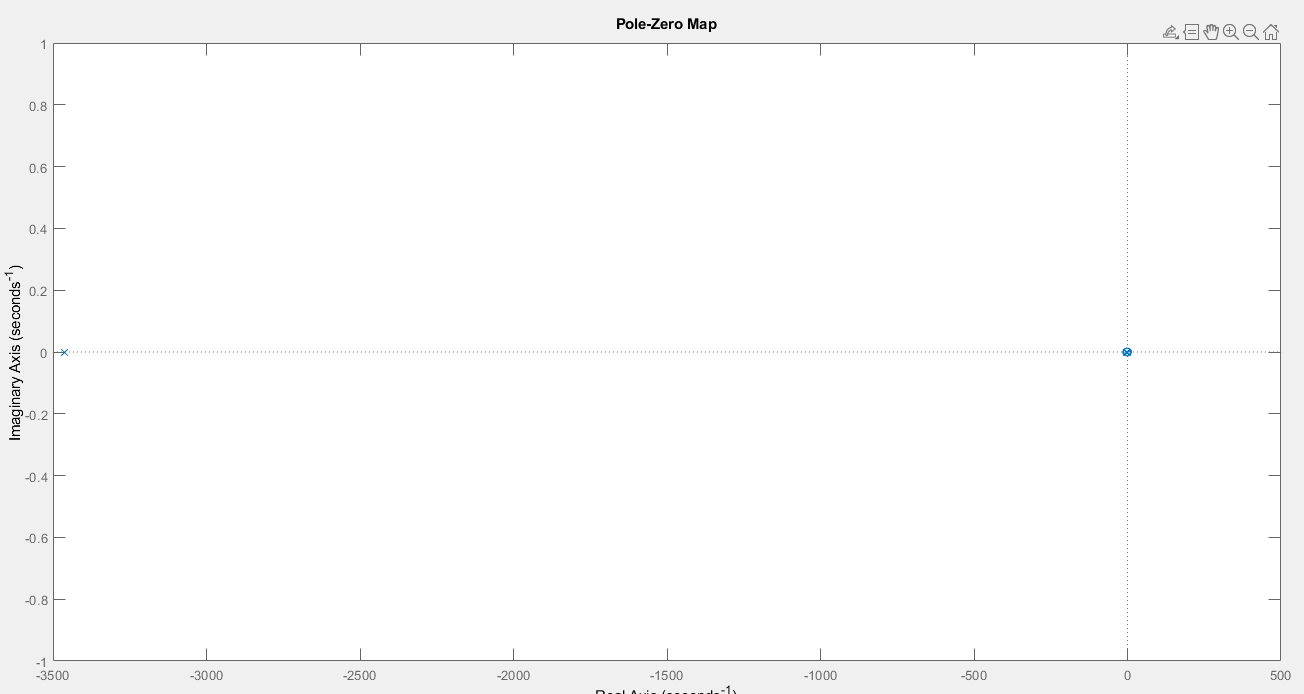
So, 2 zeroes and 2 poles will nullify their effect and 1 pole will be on the left side so that we can say that system is stable.

Pole-Zero Map and Analysis:

In this system, we will be analyzing the poles and zeros of the system when the PID controller is added to the system.

* We got 4 poles and 3 zeroes on the left side of the imaginary axis .

So, 3 zeroes and 3 poles will nullify their effect and 1 pole will be on the left side so that we can say that system is stable.



Poles of Induction Motor:

1.0e+03

-3.4615

-0.0023

0.0000

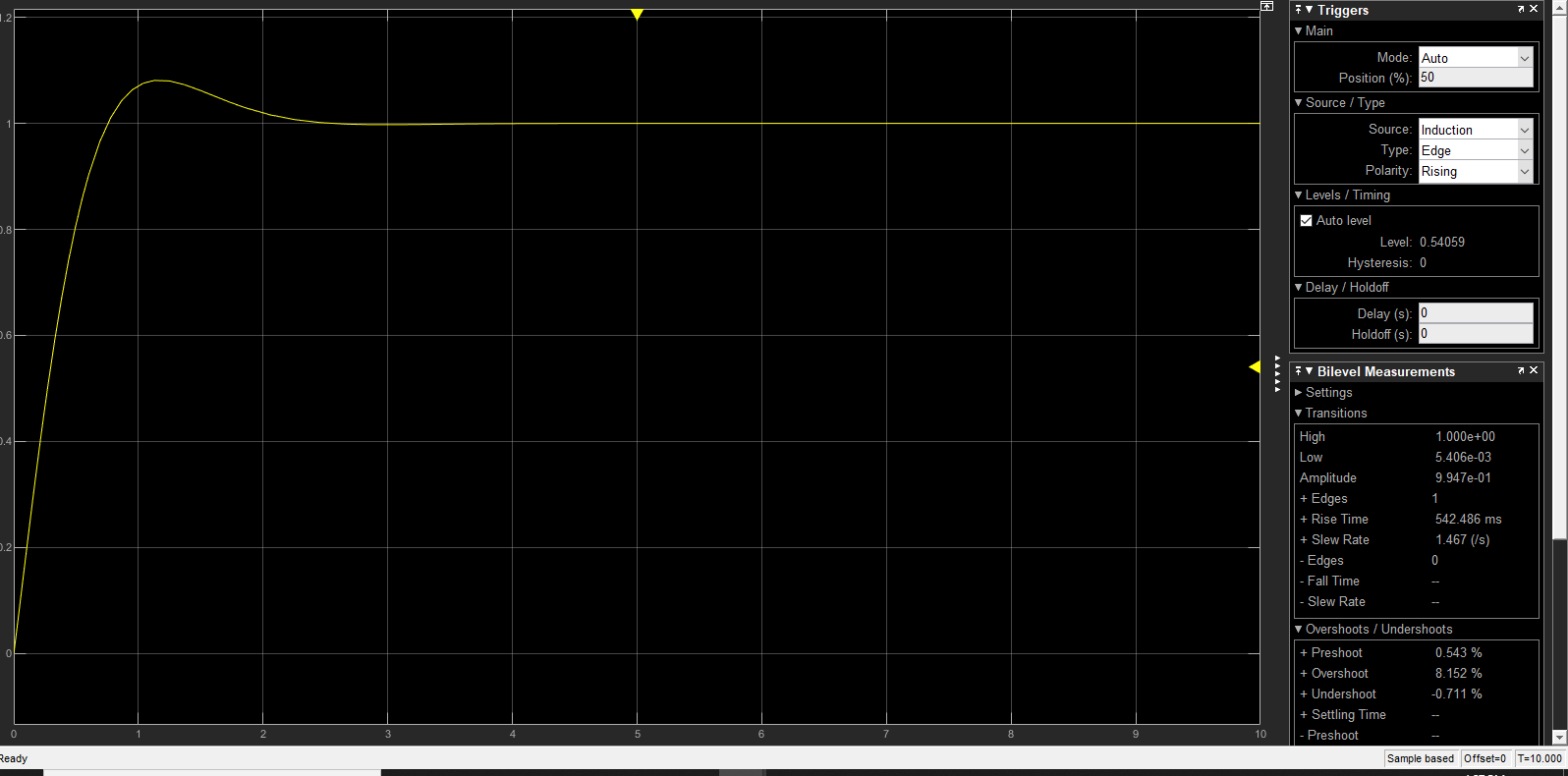
Zeroes of Induction Motor:

0

-2.7374

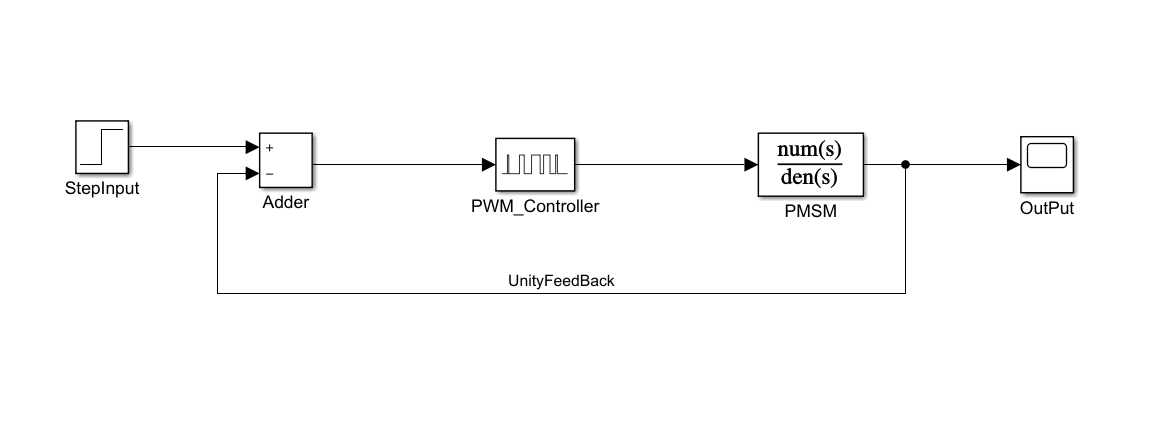
0.0118

Output Graph:

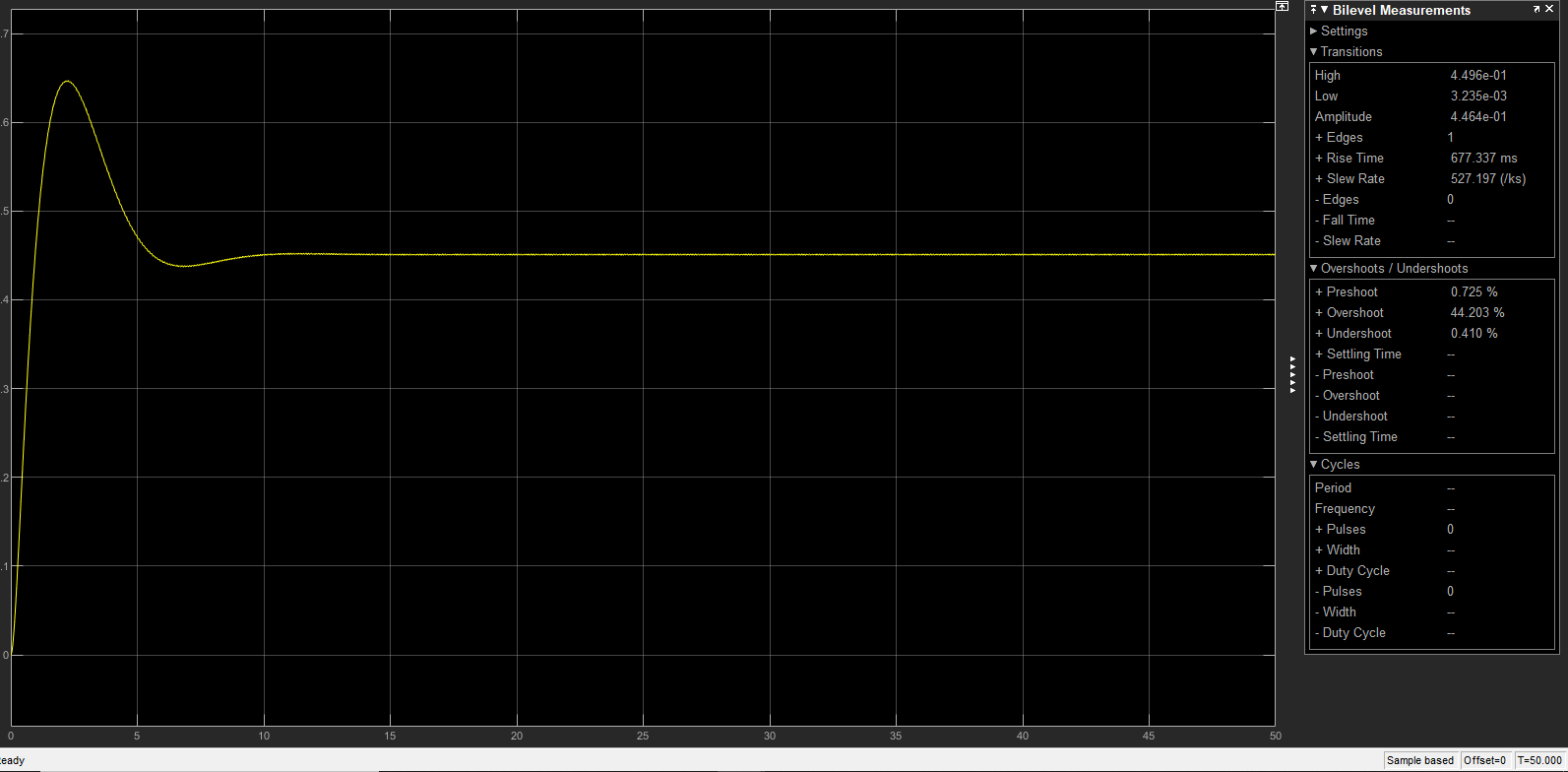


After PID tuning we got the rise time as 542.46ms and overshoot is 8.152% as the tuning made the system parameters to adjust accordingly to get the stable system.

4) PMSM Motor with PWM Controller:



Output Graph:



After PID tuning we got the rise time as 677.46ms and overshoot is 44% as the tuning made the system parameters to adjust accordingly to get the stable system.