A
PROJECT REPORT
On
“Modelling of Induction Motor”

EE514 – DESIGN AND APPLICATION OF ELECTRIC DRIVES

SUBMITTED TO: -

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2023-2025

OBJECTIVE: -

Q1: Compare the torque, speed and stator currents of both the models (Report in the docx file)
Q2: Find the slip of the motor under full load condition from both the models.
Q3: In the dq model find the magnitude of the Vqds, Iqds, Iqdr, lambda_qds, lambda_qdr'' when 2/3 constant is used for abc to qd0 transformation and compare it with Vabs, Iabcs, Iabcr', lambda_abcs, lambda_abcr' (from the phase variable model). Do similar exercise when sqrt (2/3) constant is used for the transformation.

PARAMETER: -

Sno.	Parameter	Rating
1.	Model	100 HP, 460 V, 60 Hz, 1780 RPM
2.	Pole pair	2
3.	Inertia constant	1.3
4.	Rs	0.03957
5.	Ls_leakage	0.000389
6.	Rr'	0.02215
7.	Lr_leakage'	0.000389
8.	Lm	0.000389

SOFTWARE: -

To create an induction motor model, we have used matlab Simulink environment. Simulink is a block diagram environment for multidomain simulation and Model-Based Design. It supports system-level design, simulation, automatic code generation, and continuous test and verification of embedded systems.

THEORY: -

An induction motor is a type of AC motor where the rotor (the rotating part) is not connected electrically to the power source. Instead, it operates by electromagnetic induction, where a rotating magnetic field produced by the stator (the stationary part) induces currents in the rotor, causing it to turn

- ❖ **Phase variable model**

The phase variable model is a way to represent the behaviour of an induction motor using mathematical equations based on the relationships between its electrical quantities. Here's a simplified explanation:

Vas, Vbs, Vcs: Voltages applied to the stator windings (three-phase supply)

Ias, Ibs, Ics: Currents flowing through the stator windings

Var, Vbr, Vcr: Induced voltages in the rotor (dependent on rotor speed and slip)

Iar, Ibr, Icr: Currents flowing through the rotor windings

Assumption: -

(1) Saturation effect is neglected.
(2) Machine is perfectly balanced.
(3) Skewing effect is neglected.
(4) Flux produced in the machine is sinusoidal.

- ❖ **dq0 model**

The dq0 model is a transformation technique used to simplify the analysis and control of three-phase AC machines like induction motors.

dqo transformation: -

The three-phase stator currents and voltages are transformed into a new reference frame

daxis: Aligned with the rotor flux

qaxis: Perpendicular to the rotor flux.

0axis: Represents the zero-sequence component.

Park transformation: -

The transformation from abc (three-phase) to dq0 involves rotating the coordinate system based on the rotor position. This transformation simplifies the analysis because it decouples the equations in the dq0 frame.

SIMULINK MODEL: -

Phase variable model-

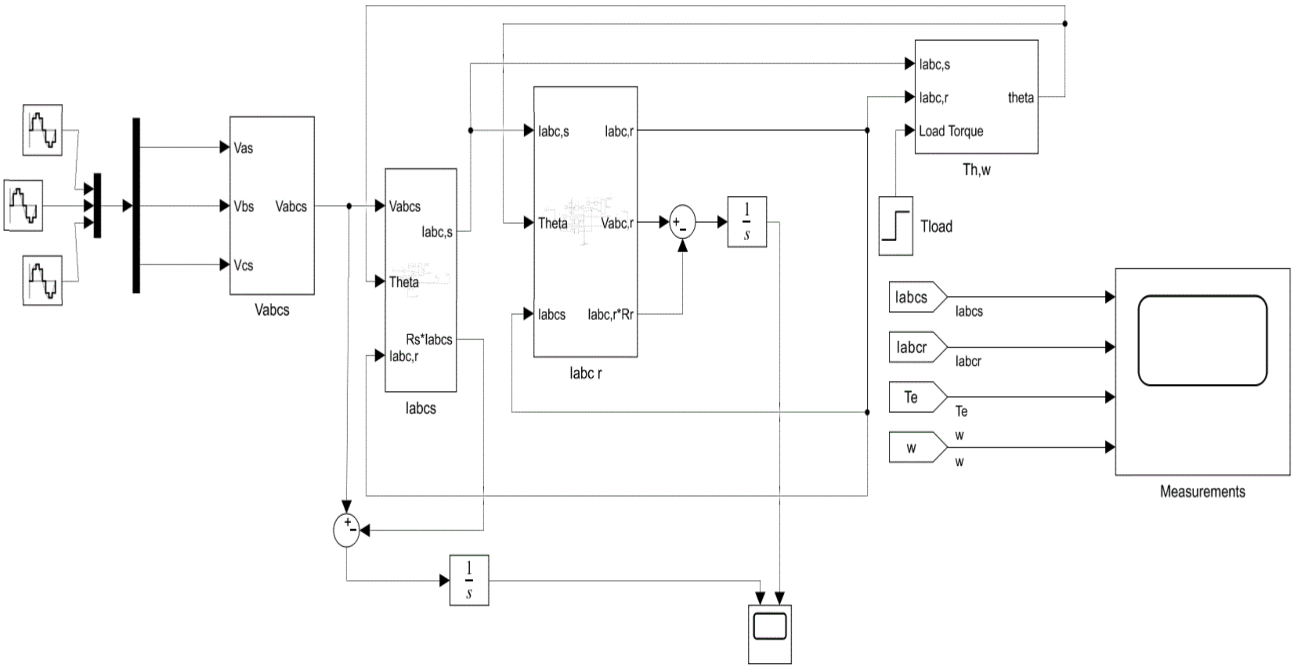


Fig. – Simulink model of phase variable

qd0 model-

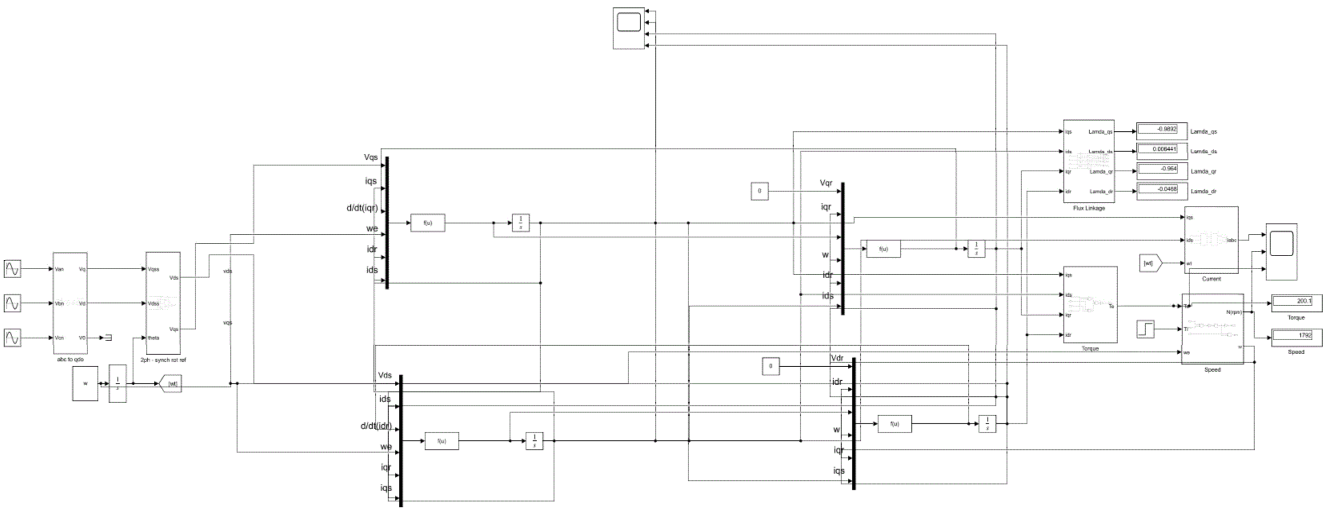


Fig. – Simulink model of qd0 model

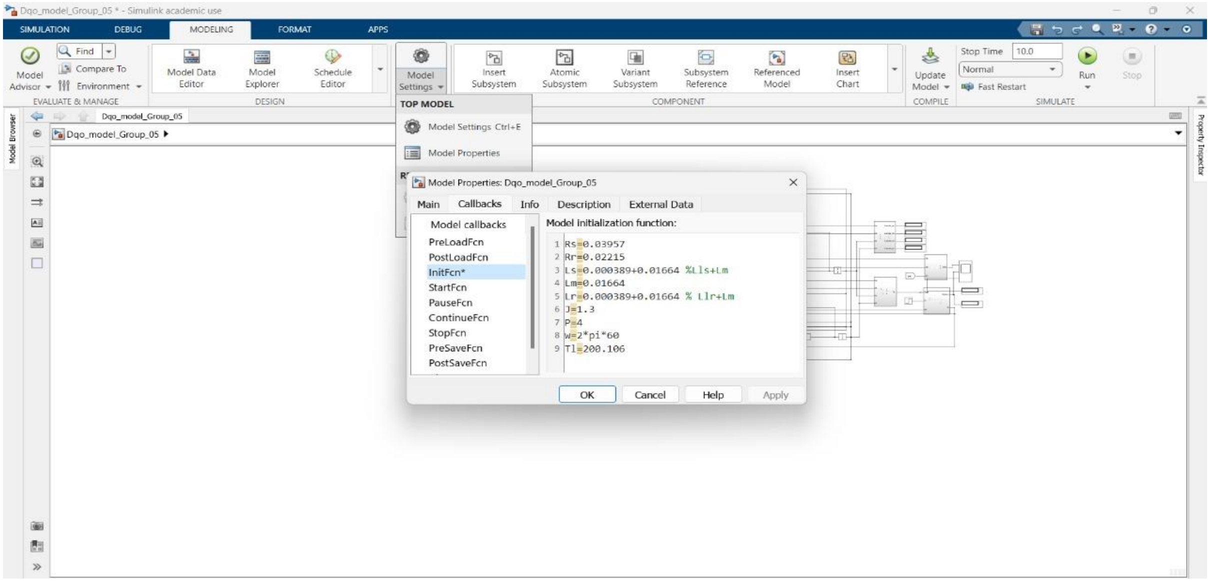


Fig. – Inserting parameter into model

OBSERVATION: -

(1). Comparison of torque, speed and currents –

Phase variable model-

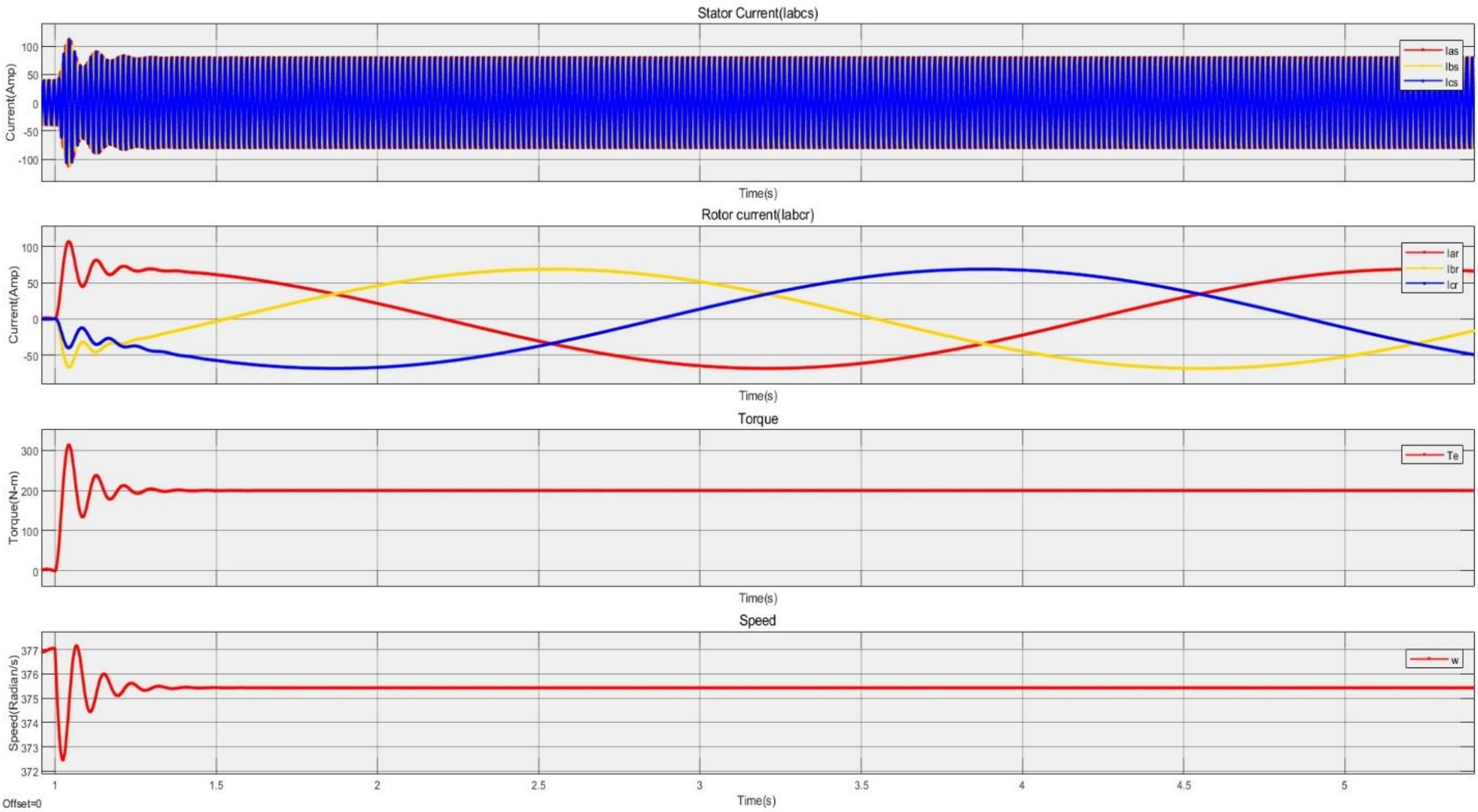


Fig. – current, speed and torque

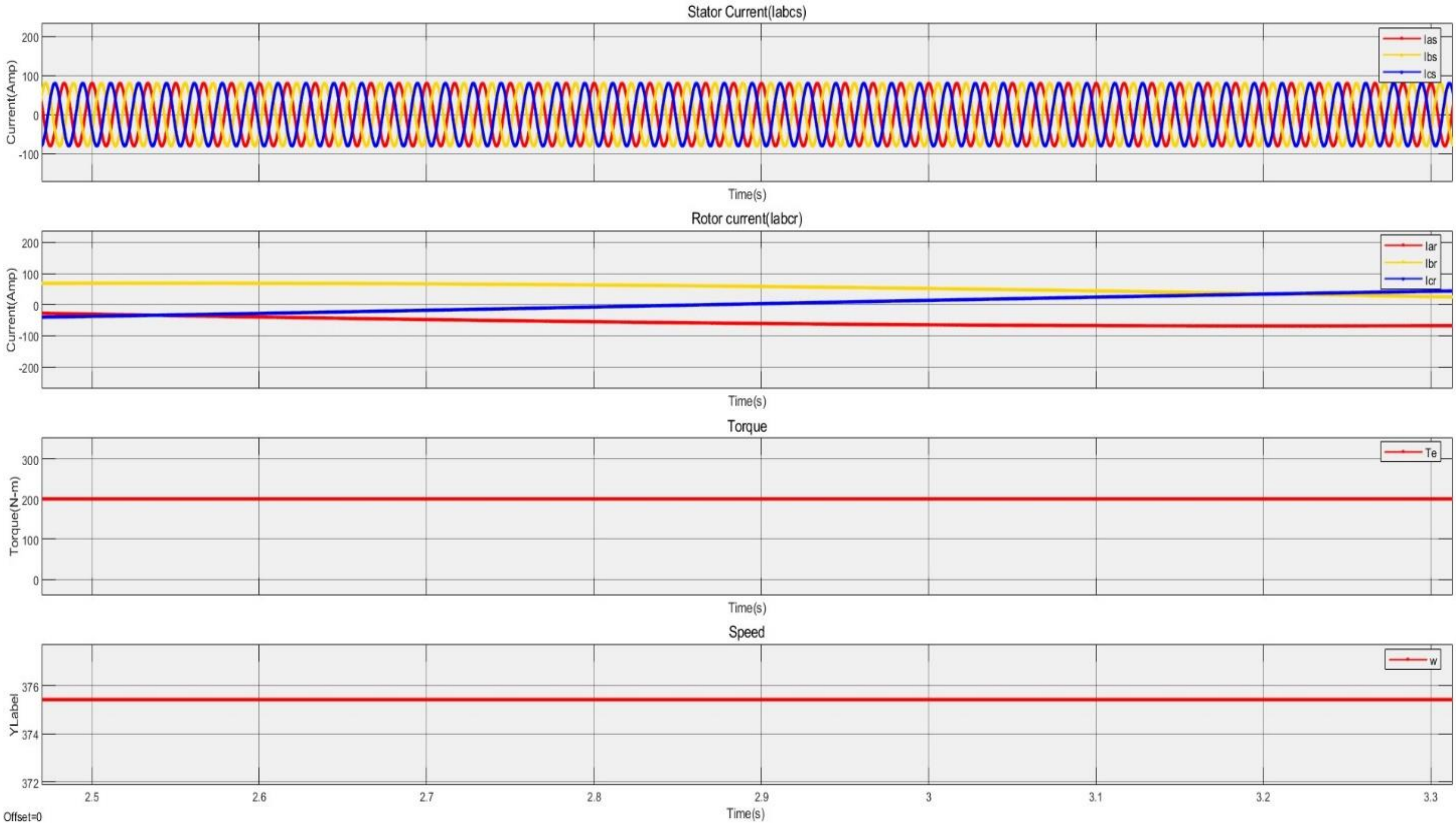


Fig. – current, speed and torque after zoom in

qd0 model-

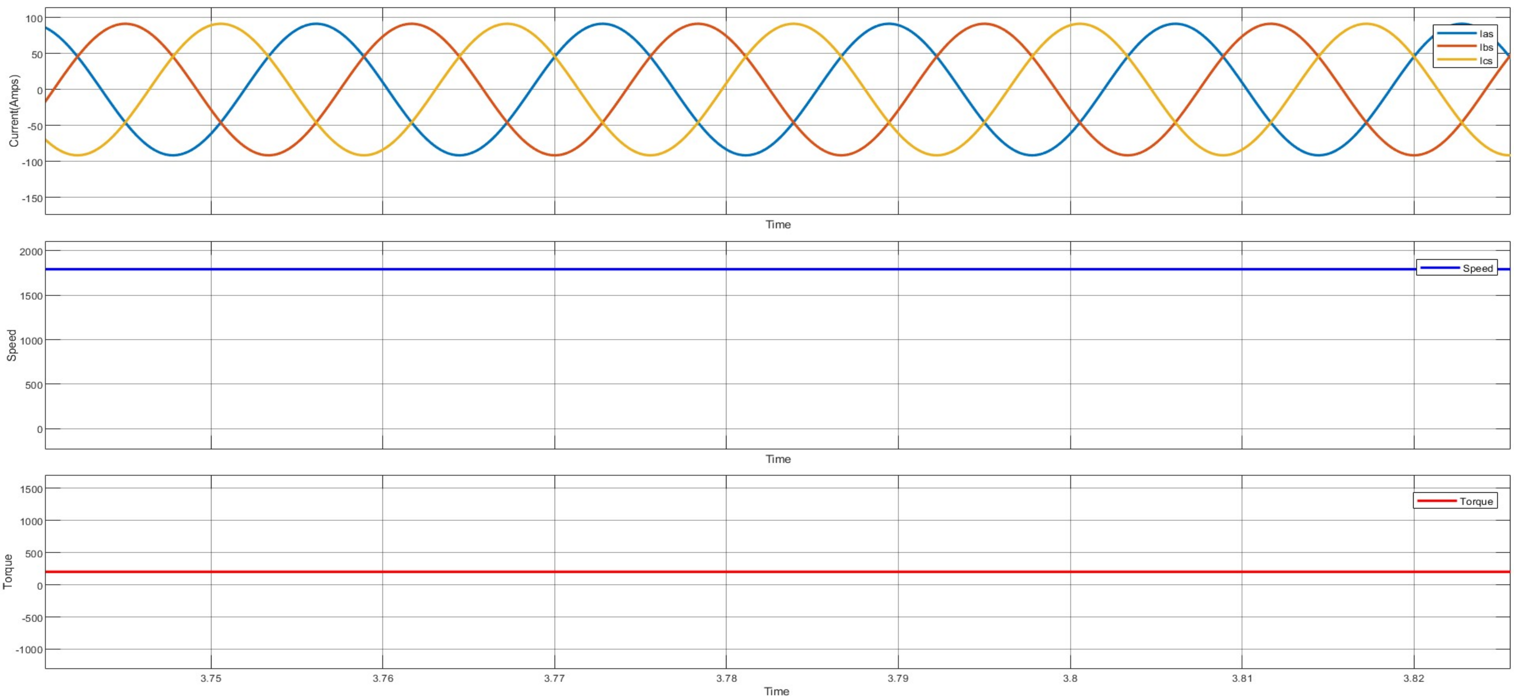


Fig. – current, speed and torque

(2). Slip of the motor –

For abc model -

Given frequency = 60Hz

Pole = 4

Rotor speed = 1780 RPM

Synchronous speed = (120*f)/P = 1800 RPM

Slip = (Ns – Nr) / Ns = (1800-!780)/1800 = 0.0111

For qdo model-

Given frequency = 60Hz

Pole = 4

Rotor speed = 1782 RPM

Synchronous speed = (120*f)/P = 1800 RPM

Slip = (Ns – Nr) / Ns = (1800-!782)/1800 = 0.01

(3). Comparison of voltage, current and flux linkage of both the models–

Phase variable model-

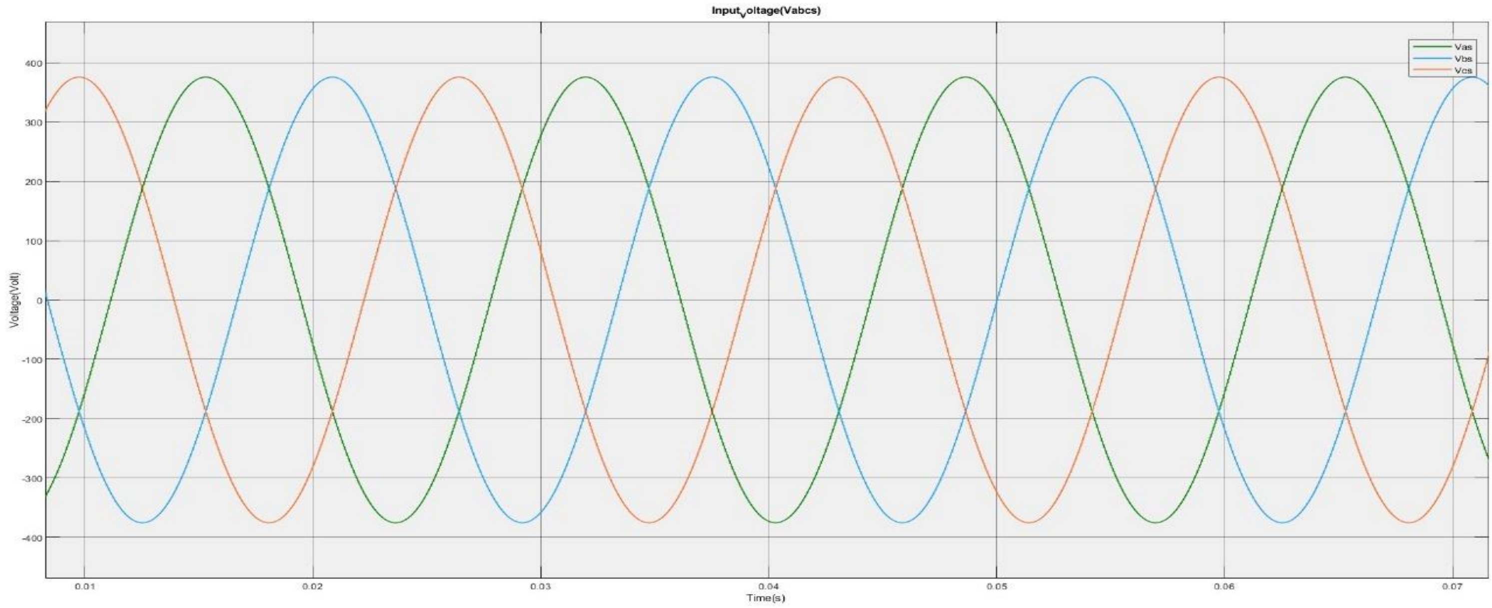


Fig. – supply voltage

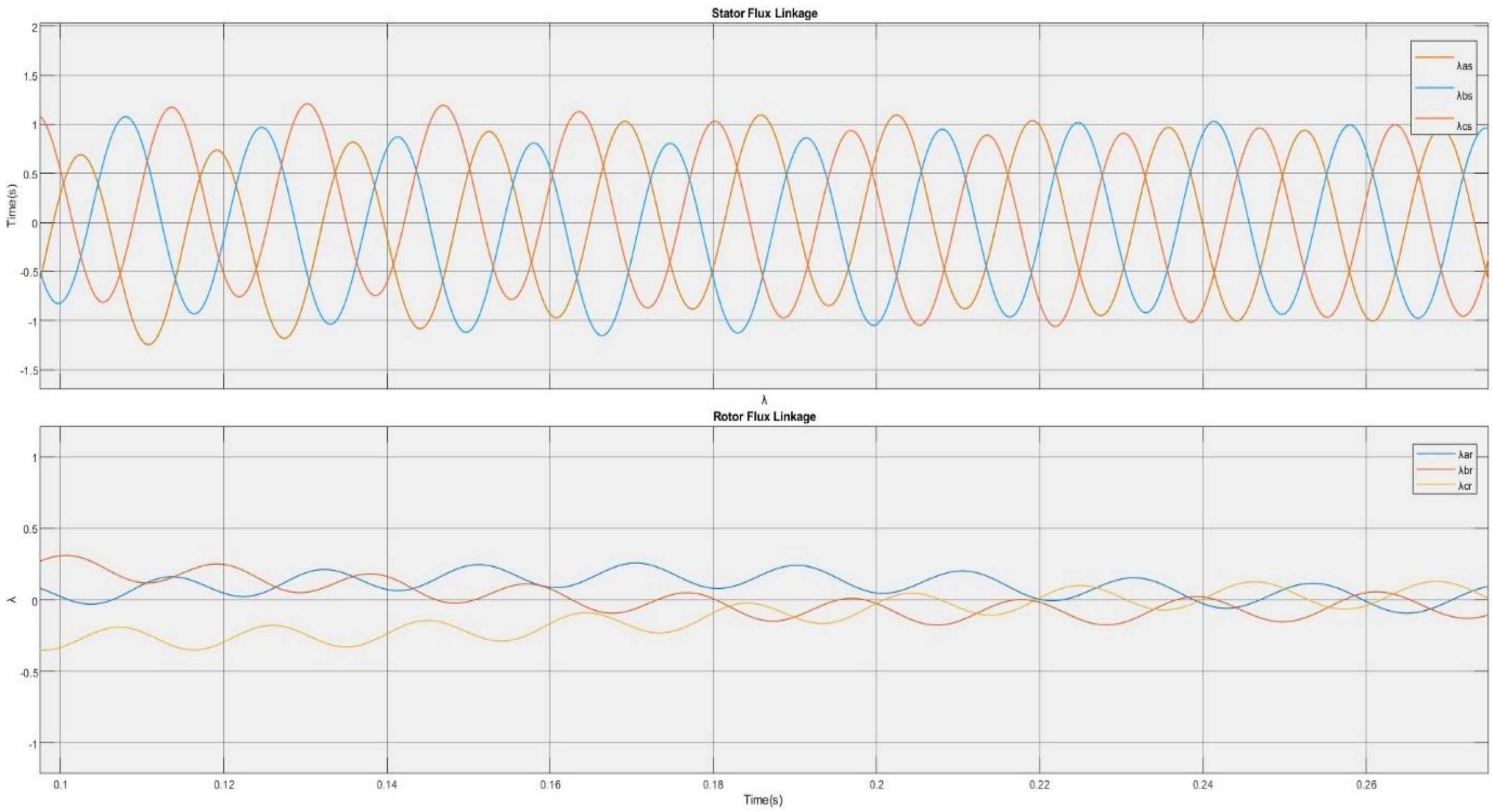


Fig. - Flux linkage

qd0 model-

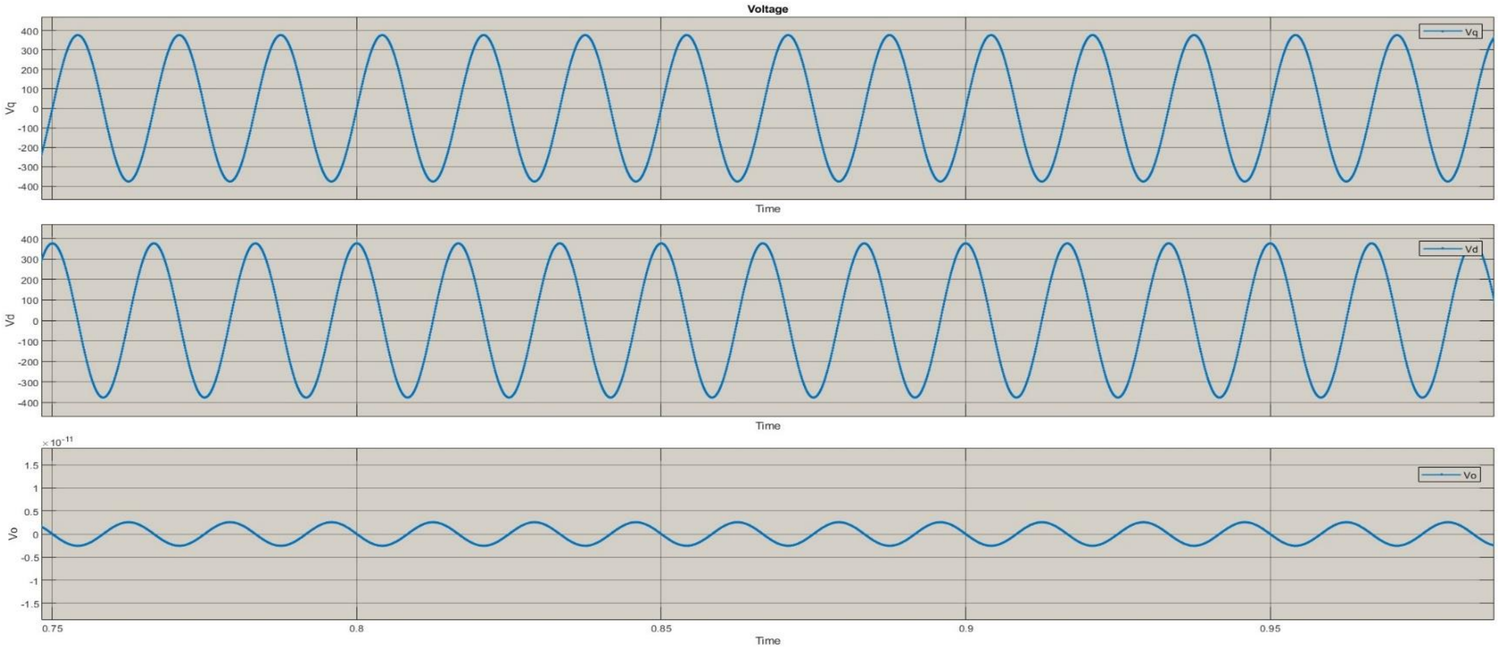


Fig. – voltage for qdo frames

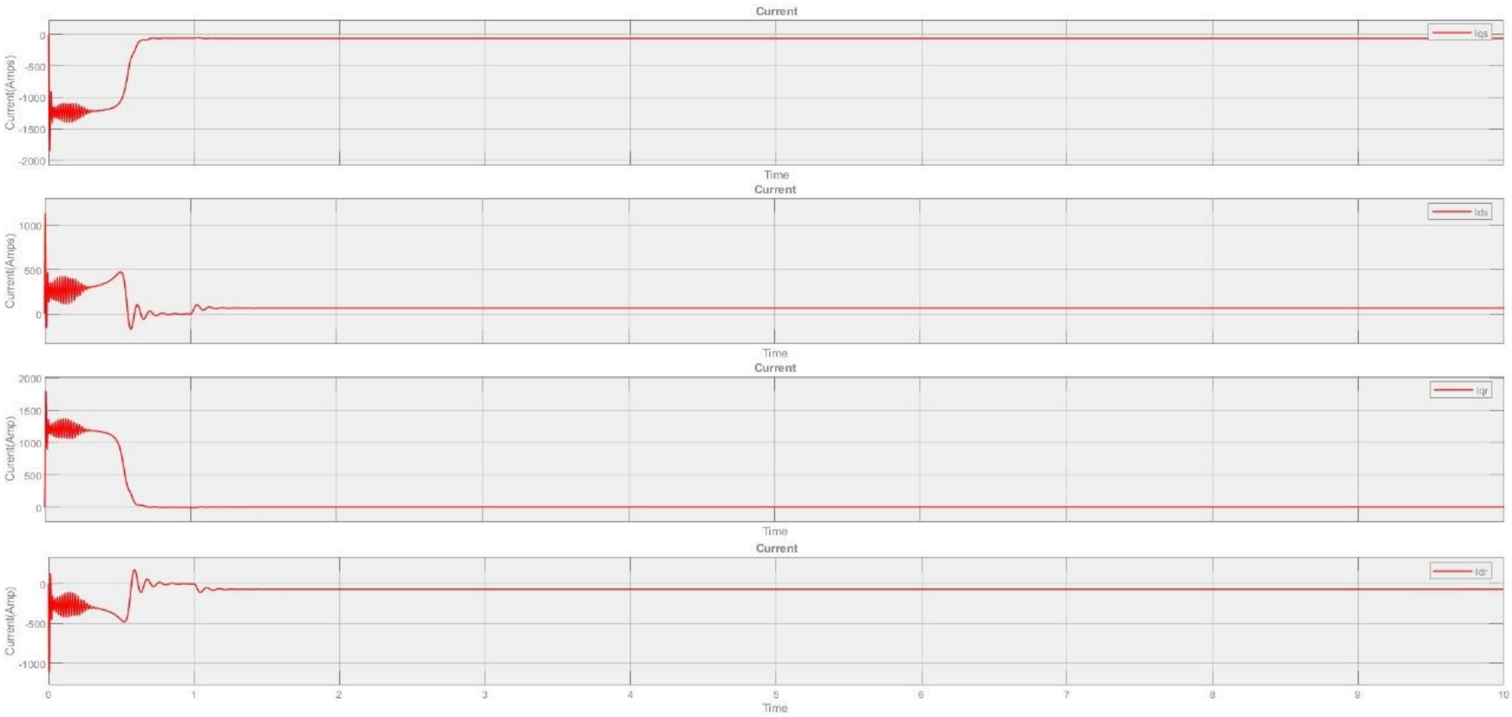


Fig. – Rotor and stator current

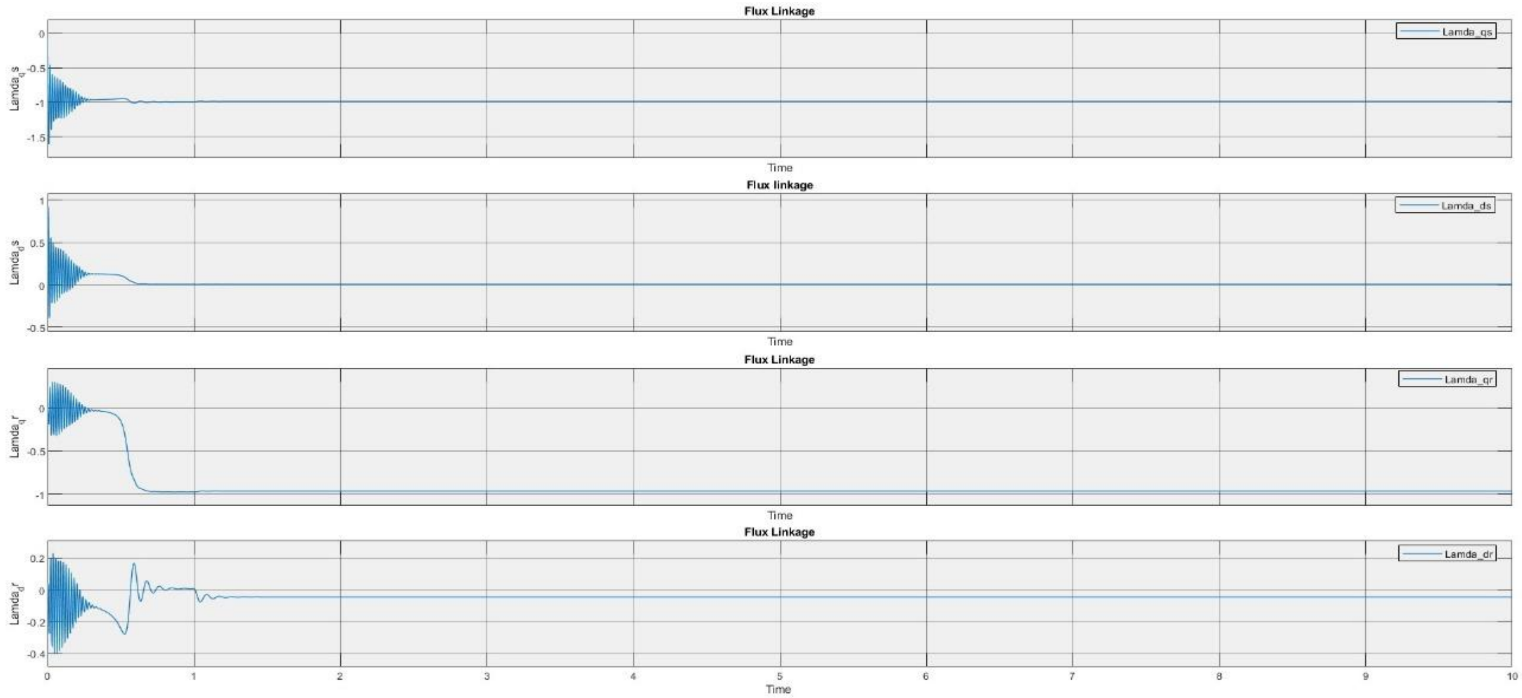
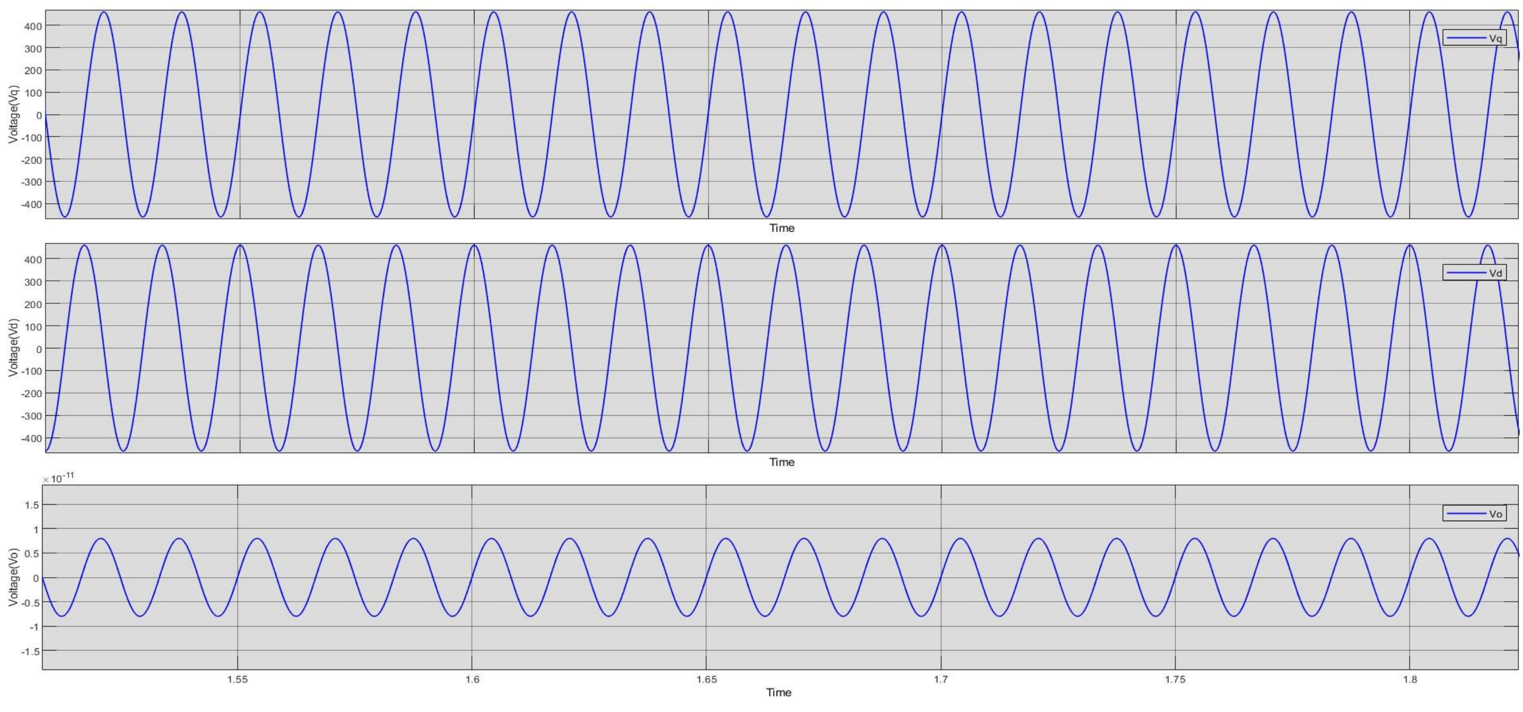


Fig. - Flux linkage

qd0 model when sqrt (2/3) constant is used for the transformation –



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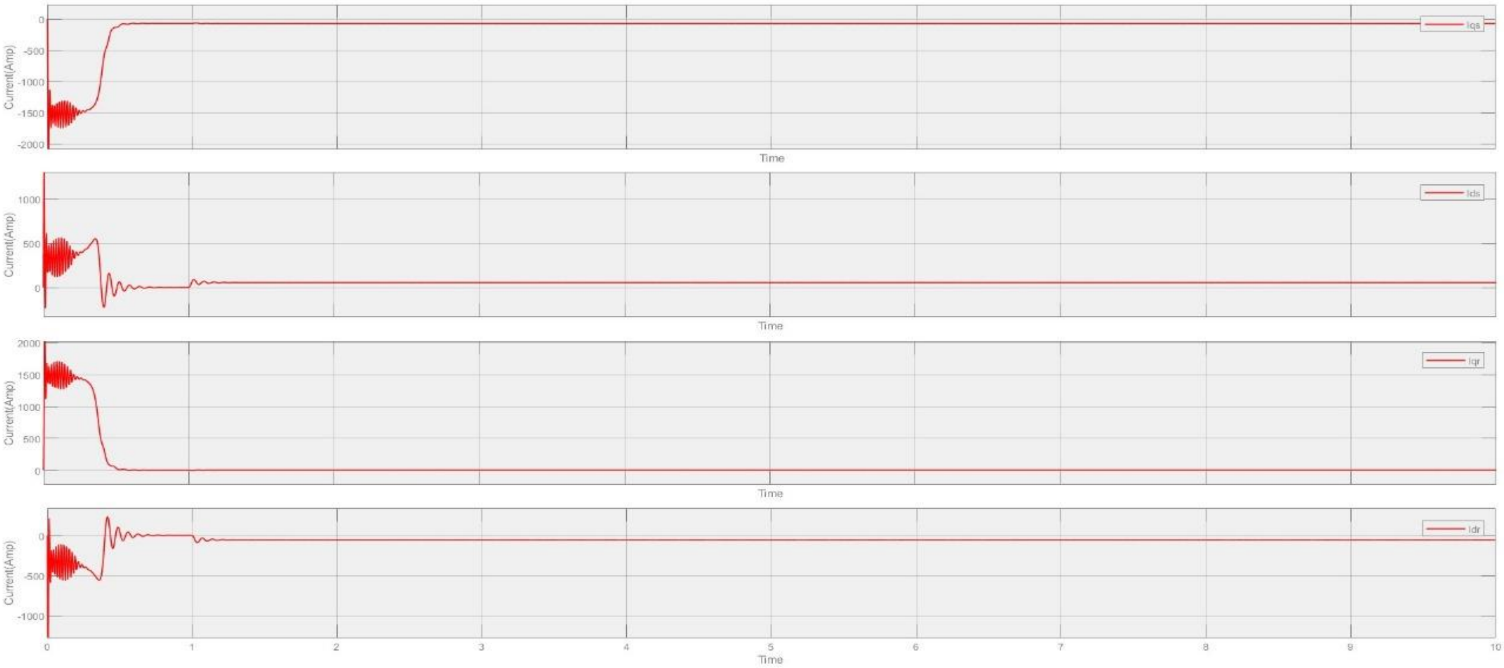

Fig. – Rotor and stator current

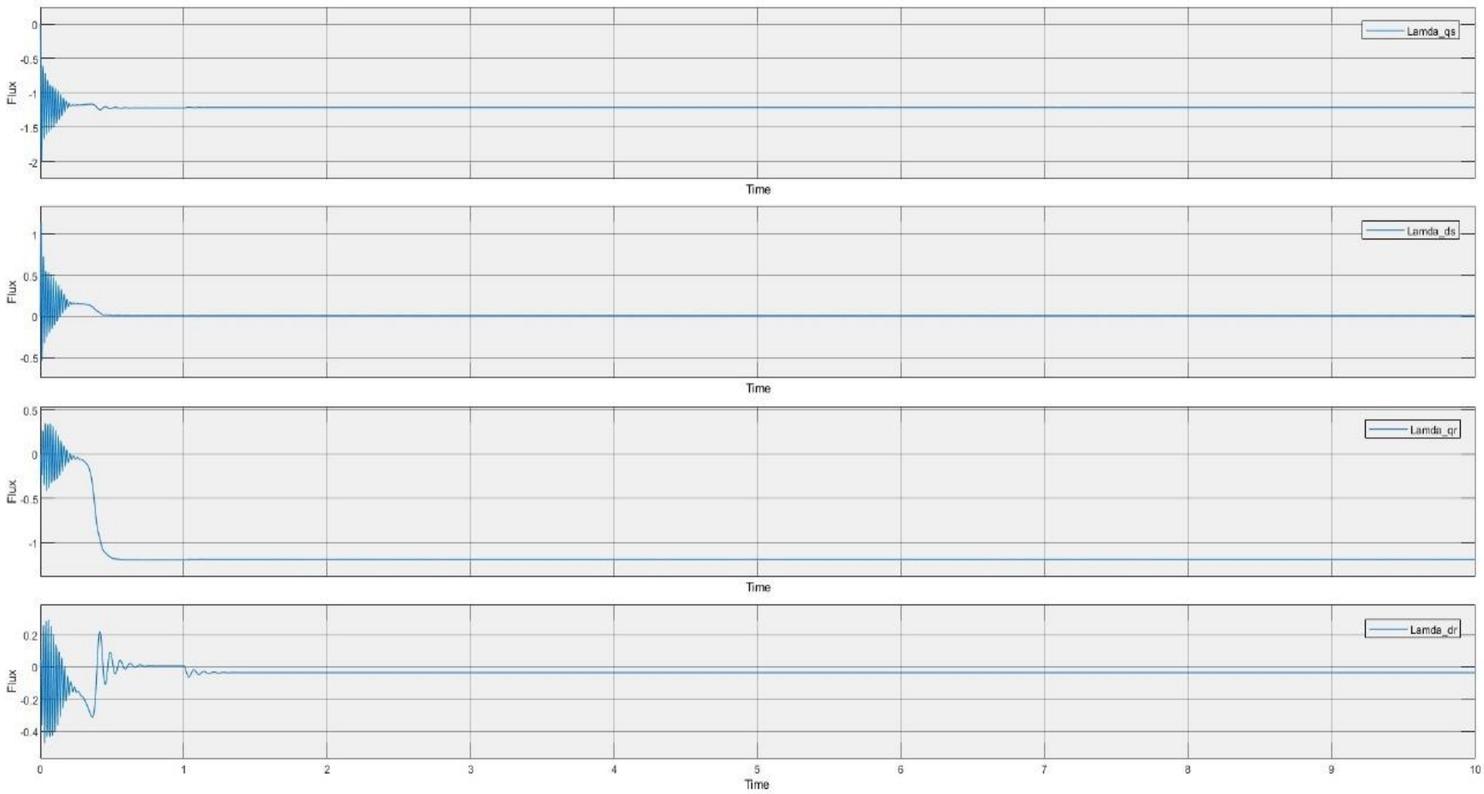

Fig. - Flux linkage

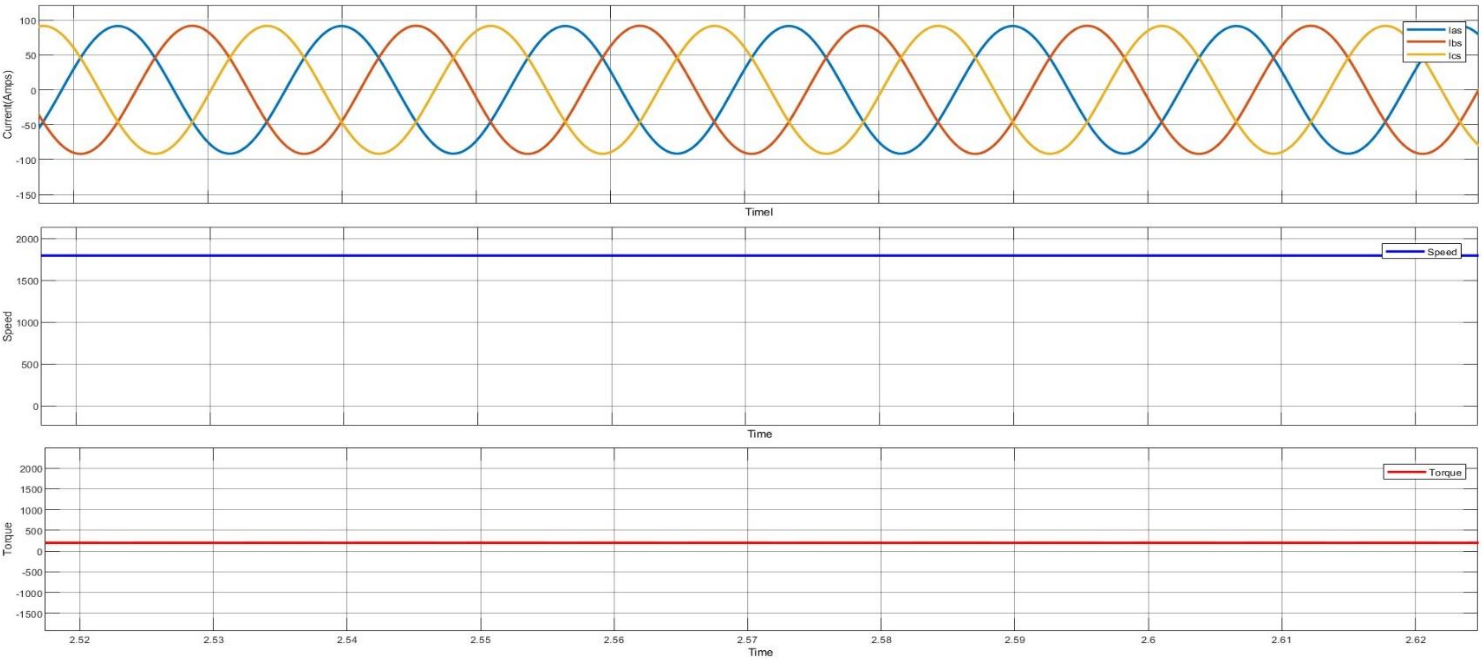

Fig. – current, speed and torque

CONCLUSION: -

We have successfully modelled the induction motor in a Simulink environment and compared the results of both phase variables as well as the qdo model of the induction motor. We found that both models gave the same results, like voltage, current, torque, speed, etc., which validated both models. We can conclude from the observations that the modeling might be different, but the end results remain the same. For easy understanding, we can go with dqo modeling, but the implementation of dqo models with different coefficients, like 2/3 or sqrt(2/3), will slightly differ in calculation basis and will not cause much difference.