19EE10026

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Date __/__/__

Machines Lab Exp 2

- No-load test data-

$V_{s,line}$	$I_{s,line}$	P_{in}	Q_{in}	N_r
400V	11.28 A	314.3W	7810VAR	1499

$$X_{nl} = \frac{Q_{nl}}{3} \times \frac{1}{I_{nl}^2} = 20.46\,\Omega$$

assuming $X_l << X_m$,

$$X_m = X_{nl} = 20.46\,\Omega$$

$$\therefore \boxed{L_m = \frac{X_m}{2\pi 50} = 0.065\,H}$$

$$\text{stator copper loss} = P_{in} - P_{rotational}$$
$$= 314.3 - T_e \times \omega$$
$$= 243.78W$$

$$\text{and } P_{cu,nl} = 3 I_{nl}^2 R_s$$

$$\Rightarrow \boxed{R_s = 0.638\,\Omega}$$

- Blocked Rotor Test -

$V_{s,line}$	$I_{s,line}$	P_{in}	Q_{in}
15.67 V	22.60 A	485.2W	361.8 VAR

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$X_b = \frac{Q_b}{3I_b^2} = 0.236\,\Omega$, $R_b = \frac{P_b}{3I_b^2} = 0.316\,\Omega$

$R_b + jX_b = R_s + jX_s + (R_r' + jX_r') \parallel jX_m$

$\Rightarrow X_b = X_s + X_r' \left(\frac{X_m}{X_r' + X_m}\right)$

and $R_b = R_r' + R_s \left(\frac{X_r' + X_m}{X_m}\right)^2$

taking $X_s = X_r' = K$

$\Rightarrow K^2 + K(2X_m - X_b) - X_m X_b = 0$

or $K^2 + 40.684K - 4.82856 = 0$

$\Rightarrow K = 0.1182$

so $\boxed{L_s = L_r' = \frac{K}{2\pi 50} = 0.00094\,H}$

$R_r' = R_b - R_s \left(\frac{X_r' + X_m}{X_m}\right)^2$

$\boxed{R_r' = 0.961\,\Omega}$

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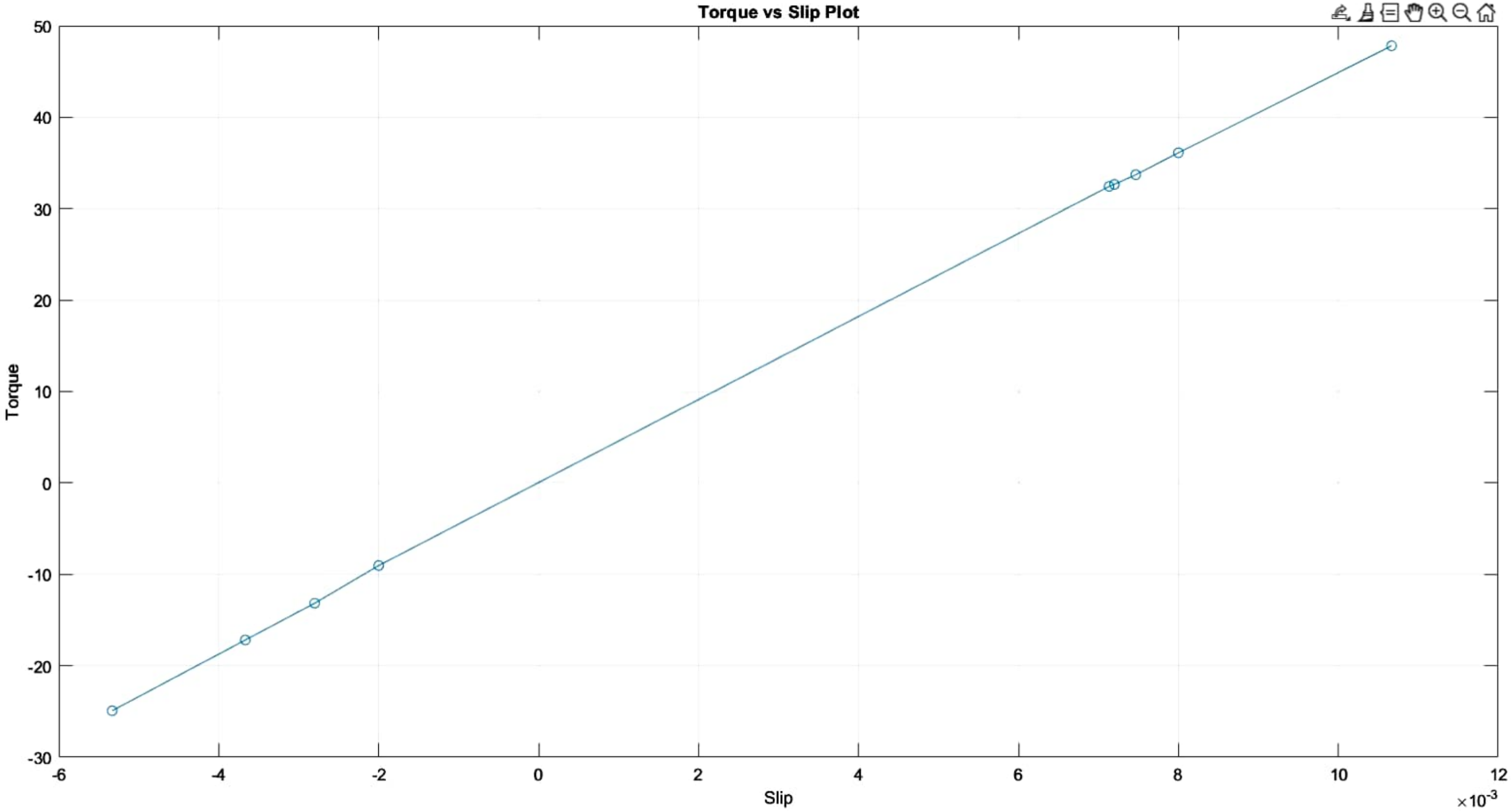
- Load Test data -

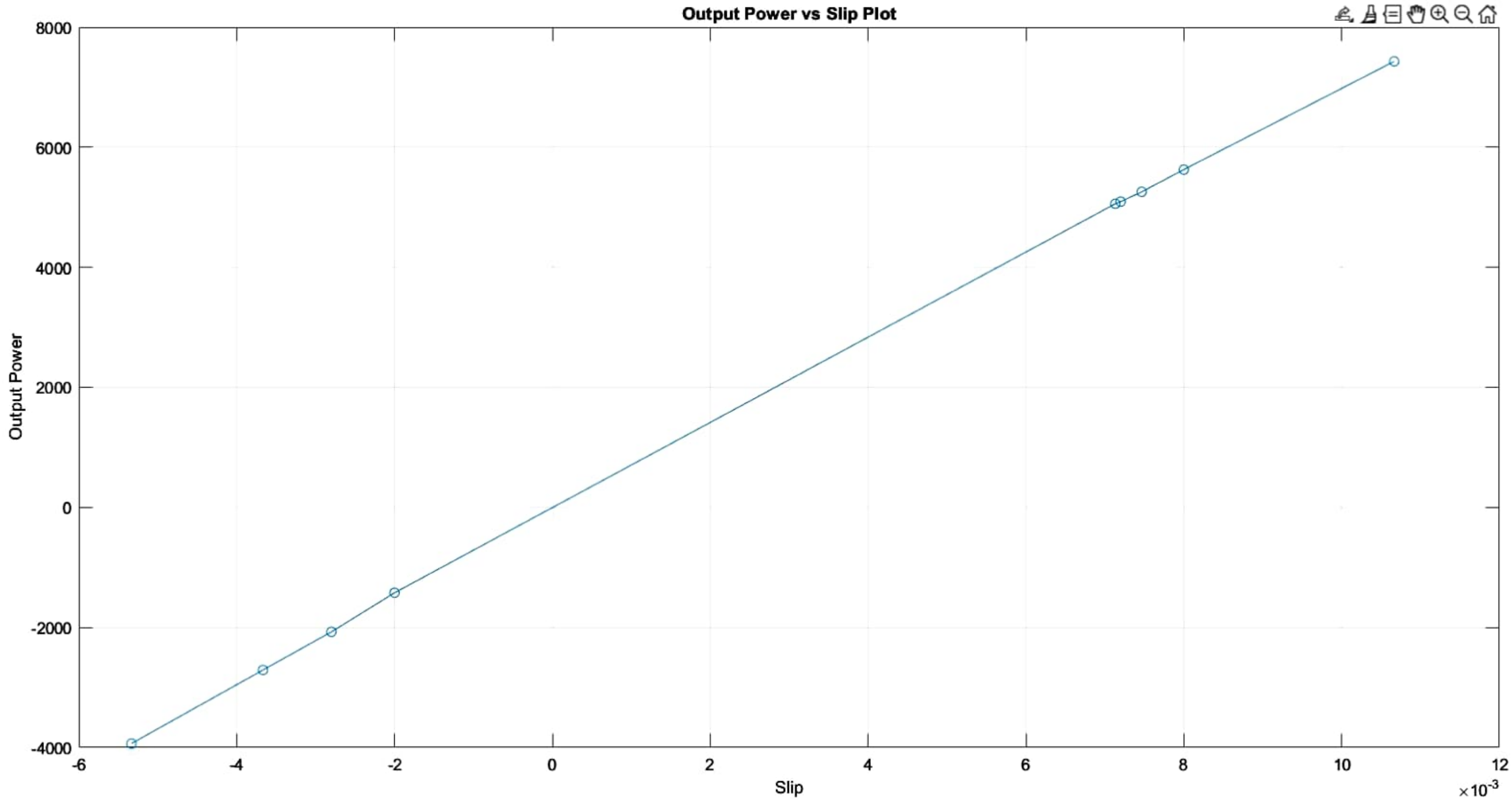
Induction Motor					DC Motor	
V_{ph} (V)	I_{ph} (A)	N_r (rpm)	P_{out}	T_e (Nm)	V_a (V)	I_a (A)
230.9	15.68	1484	7431.4	47.82	342.5	-6.85
230.9	13.93	1488	5626.8	36.11	348.5	-1.742
230.9	13.61	1488.8	5257.2	33.72	349.7	-0.69
230.9	13.48	1489.2	5093.3	32.66	350.3	-0.23
230.9	13.45	1489.3	5059.3	32.44	350.4	-0.14

- Grid connection -

Induction Motor					DC Motor			
V_{ph} (V)	I_{ph} (A)	N_r (rpm)	P_{out} (W)	T_e (Nm)	V_a (V)	I_a (A)	V_f (V)	I_f (A)
230.9	11.49	1503	-1422	-9.04	349.8	19.2	350	2.52
230.9	11.70	1504.2	-2072.9	-13.16	349.8	21.3	350	2.49
230.9	11.97	1505.5	-2708	-17.18	349.8	23.3	350	2.48
230.9	12.67	1508	-3935	-24.12	349.8	27.4	350	2.46



Torque vs Slip Plot
Torque
Slip
50
40
30
20
10
0
-10
-20
-30
-6
-4
-2
0
2
4
6
8
10
12
$\times 10^{-3}$


Output Power vs Slip Plot
Output Power
Slip
8000
6000
4000
2000
0
-2000
-4000
-6
-4
-2
0
2
4
6
8
10
12
$\times 10^{-3}$

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Discussion questions-

1) Even though there is no-load, the input power to the induction motor is dissipated as the iron losses, which is read by the wattmeter. This is the reason why wattmeter shows a reading even though power dissipated across load is 0.

2) ~~The iron losses are~~ The main component of no load losses are the core loss, friction loss and windage loss. The rotor copper loss is negligible because the current flowing through the circuit is negligible compared to the rated current. But the voltage in noload test is approximatly same as rated voltage. So stator losses are read by the wattmeter.

3) In blocked rotor test, core losses are very low due to low voltage supply. Frictional losses are also negligible as rotor is not moving. The stator copper loss and rotor copper loss are the main component of blocked rotor test. This is because low voltage is supplied which makes core loss negligible, and rated current flows in the circuit. so copper losses are significant.

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4) Power absorbed by $\left(\frac{r_2'}{s}\right)$ signifies the air gap power P_{ag}.
Power absorbed by (r_2') signifies the rotor copper loss.
Power absorbed by $r_2'\left(\frac{1}{s}-1\right)$ signifies the gross mechanical power generated by the induction machine.

This satifies the relation

P_{ag} : Rotor Cu loss : gross mech output $= 1 : s : (1-s)$

and $P_{ag} = P_{rotor\ cu\ loss} +$ gross mech power

5) The different losses present in induction machine are frictional loss, core loss, windage loss, stator copper loss and rotor copper loss.