Experiment-5

No Load and Blocked Rotor test on 3-phase Induction Motor.

Group Number : 9

200020031,200020042,180020010

AIM:

To determine the equivalent circuit parameters of an induction motor from no load and blocked rotor tests.

MACHINE SPECIFICATIONS:

3 Phase AC squirrel cage induction motor

Rated Voltage- 415 V

Rated Current – 1.6 A

Rated RPM – 15 W

CIRCUIT DIAGRAMS:

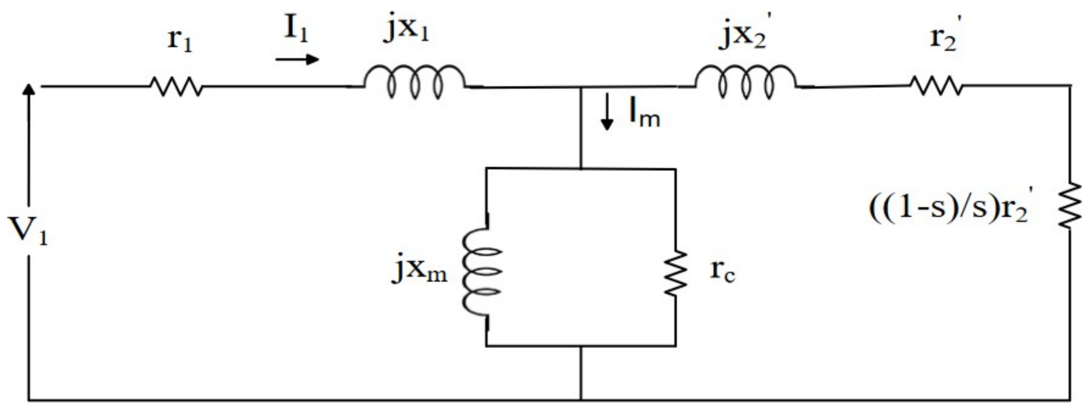
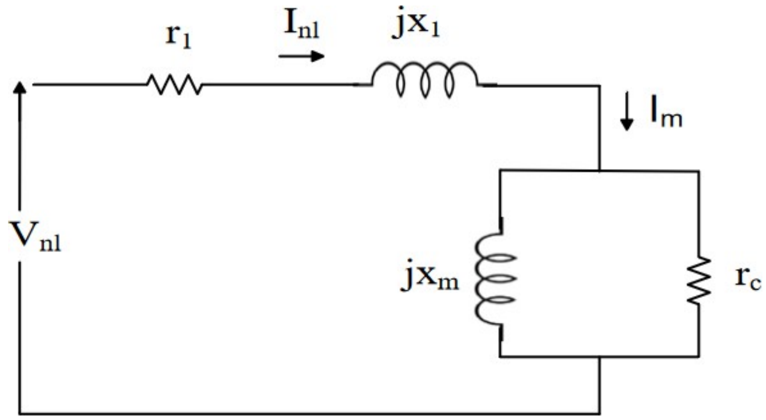
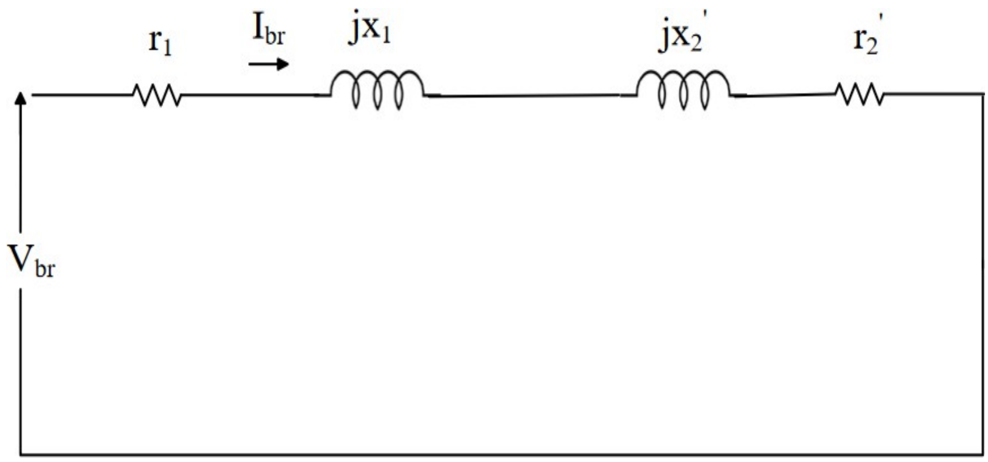


Fig. 1. Per phase equivalent circuit of 3-phase induction motor

No Load Test:



Blocked Rotor Test:



OBSERVATIONS:

No Load Test:

<table>
<tr><td>Voltage (V)</td><td>Current (A)</td><td>Power (KW)</td><td>Power (KVA)</td></tr>
<tr><td>414.6</td><td>1.309</td><td rowspan="3">0.145</td><td rowspan="3">0.966
0.955(r)</td></tr>
<tr><td>415.3</td><td>1.297</td></tr>
<tr><td>416.3</td><td>1.371</td></tr>
</table>

Blocked Rotor Test:

Voltage (V)	Current (A)	Power (KW)	Power (KVA)
119.6	**1.831**		
119.7	**1.806**	**0.194**	**0.379** **0.326(r)**
121.1	**1.846**		

CALCULATIONS:

For no-load test:

The no-load test approximates the stator circuit (R1and X1) and magnetization branch parameters(Xm) of an induction machine. The machine is brought to its rated speed by applying rated three phase volt-age at the stator (Vnl). Corresponding no-load current (Inl) and no-load real power input(Pnl) are recorded.

When no mechanical load is driven by the machine, slip (s) is a very small value. As a result, referring to Fig.(1), the rotor circuit branch resistance quantity, R(1−s/s) carries a large value. The impedance of rotor circuit branch is thus much higher compared to the magnetization branch impedance and their parallel combination would turn out to be close to jXm (neglecting core conductance).

$$R_s \text{ is large as compared to } X_m$$

$$Z_{nl}=\frac{V_{nl}}{I_{nl}}=\frac{415}{1.297}=319.96\,\Omega$$

$$R_{nl}=\frac{P_{nl}(r)/3}{I_{nl}^2}=\frac{955/3}{1.297^2}=189.3\,\Omega$$

$$Z_{nl}=\sqrt{R_{nl}^2+X_{nl}^2}$$

$$X_{nl}=\sqrt{Z_{nl}^2-R_{nl}^2}=\sqrt{319.96^2-189.3^2}=257.87\,\Omega$$

For Blocked - rotar test:

The blocked rotor test is performed to estimate parameters that affect machine’s performance under load such as its leakage impedance, similar to the short circuit test done for a transformer. In blocked rotor test, the machine shaft is locked or is prevented from rotating via external means.

With the rated current (Ibr) flowing in the stator, we note the stator applied voltage (Vbr) and the power input(Pbr). It should be noted that the rotor position in blocked state affects the stator voltage (Vbr) required for setting up Ibr. Hence, an average calculated over different rotor positions can be taken. Assuming we have the stator circuit parameters Rs ready, the other machine parameters can be calculated as indicated below.

$$Z_{br}=\frac{V_{br}}{I_{br}}=\frac{119.7}{1.806}=66.28\,\Omega$$

$$R_{br}=\frac{P_{br}(r)/3}{I_{br}^2}=\frac{326/3}{1.806^2}=33.31\,\Omega$$

$$X_{br}=\sqrt{Z_{br}^2-R_{br}^2}=\sqrt{66.28^2-33.31^2}=57.3\,\Omega$$

Again, in general, as Xm >> Xr1, $\frac{X_2}{X_m}$ can be neglected which yields,

$$X_{br}\approx X_1+X_2$$

For wound-rotor construction, one can assume that X1 ≈ X2 resulting in

$$X_1=X_2=0.5\times X_{br}=28.65\Omega$$

$$X_m=X_{nl}-X_1$$

$$X_m = \quad 257.87 - 28.65 = 229.22\ \Omega$$

$$r_1=R_{nl}=189.3\Omega$$

from network equation, after simplifying we got :

$$r_2=(R_{nl}-R_{br})\left(\frac{X_m}{X_2}\right)^2$$

$$r_2 = 9.98\ \text{k}\Omega$$

RESULT:

The parameters for the simplified model of the per-phase equivalent for a three-phase induction motor were calculated to be:

No-Load	Circuit Parameters	Blocked-Rotor
R_{nl} = 189.30 Ω X_{nl} = 257.87 Ω Z_{nl} = 319.96 Ω	R_s = 189.30 Ω X_1 = 28.65 Ω X_m = 229.22 Ω	R_{br} = 33.31 Ω X_{br} = 57.3 Ω Z_{br} = 66.28 Ω