INDUCTION MOTOR-I (ASYNCHRONOUS MOTOR)

UNIT-III

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CONTENTS

No load & Blocked rotor tests, efficiency

Lecture No. 7 & 8

NO LOAD & BLOCKED ROTOR TESTS

No Load Test:

It is performed to obtain the magnetizing branch parameters (shunt parameters) in the induction machine equivalent circuit. In this test, the motor is allowed to run with no-load at the rated voltage of rated frequency across its terminals.

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Machine will rotate at almost synchronous speed, which makes slip nearly equal to zero. This causes the equivalent rotor impedance to be very large (theoretically infinite neglecting the frictional and rotational losses). Therefore, the rotor equivalent impedance can be considered to be an open circuit which reduces the equivalent circuit diagram of the induction machine (Fig. 1) to the circuit as shown in Fig. 2.

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Hence, the data obtained from this test will give information on the stator and the magnetizing branch. The connection circuit diagram of no load test is shown in Fig. 3. The no load parameters can be found from the voltmeter, ammeter, and wattmeter readings obtained when the machine is running at no load as shown below:

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Readings Obtained:

1. Line to line voltage at stator terminals : V_{nl} volts
2. Stator Phase Current : I_{nl} amps
3. Per phase power drawn by the stator : P_{nl} watts

Calculations:

$$Z_{nl} = \frac{(V_{nl} / \sqrt{3})}{I_{nl}} \text{ ohms}$$

$$r_{nl} = \frac{P_{nl}}{I_{nl}^2} = r_1 + r_c \text{ ohms}$$

$$X_{nl} = \sqrt{Z_{nl}^2 - R_{nl}^2} = X_1 + X_m \text{ ohms}$$

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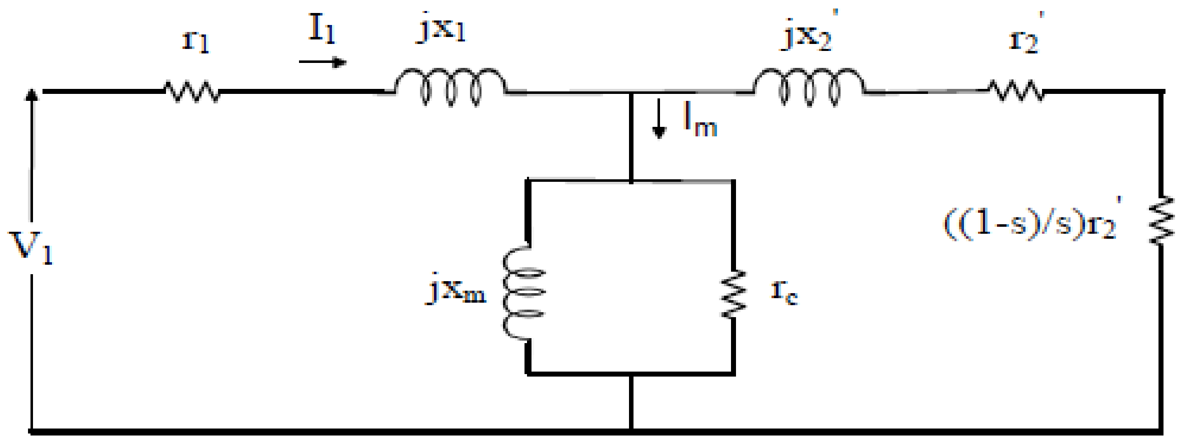

Fig. 1. Per phase equivalent circuit of 3-phase induction motor

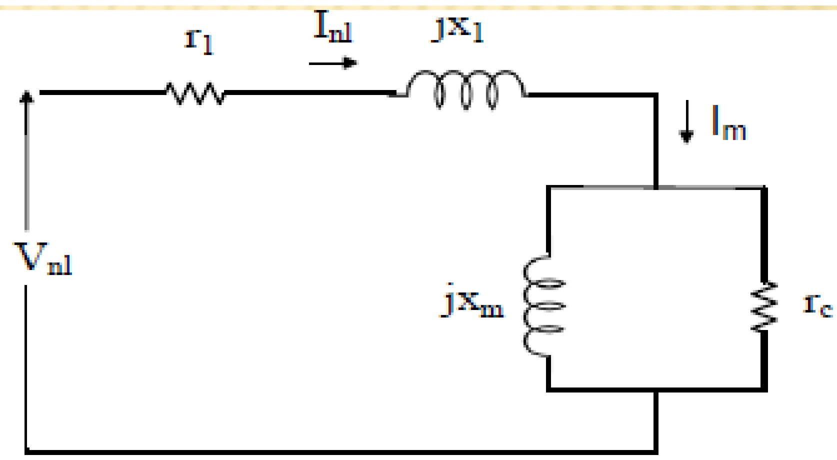

Fig. 2. Approximate Equivalent Circuit for No-Load Test

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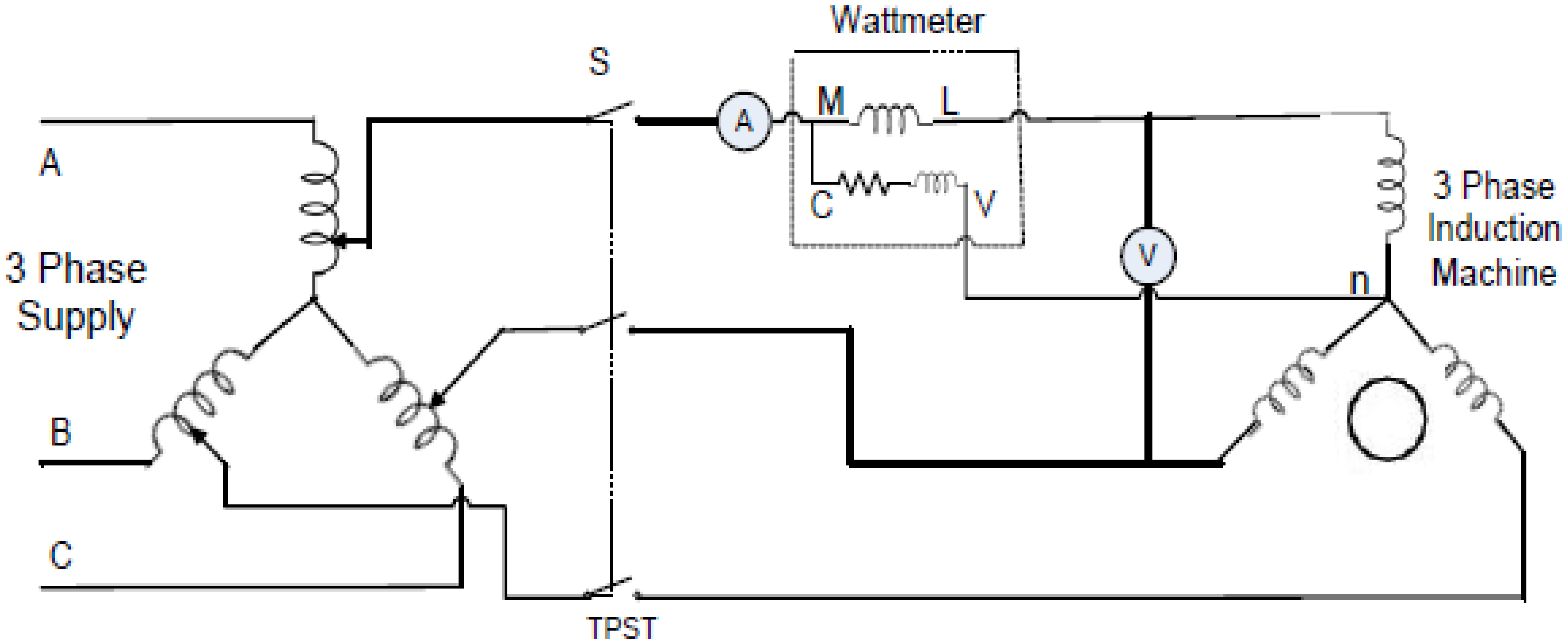

Fig. 3. Connection diagram for performing No-load and Blocked Rotor tests on 3 phase Induction machine

BLOCKED ROTOR TEST

Blocked rotor test is similar to the short circuit test on a transformer. It is performed in the to calculate the series parameters of the induction machine i.e., its leakage impedances. The rotor is blocked to prevent rotation and balanced voltages are applied to the stator terminals at a frequency of 25 percent of the rated frequency at a voltage where the rated current is achieved. Under the reduced voltage condition and rated current, core loss and magnetizing component of the current are quite small percent of the total current, equivalent circuit reduces to the form shown in Fig. 4.

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The slip for the blocked rotor test is unity since the rotor is stationary.

The resulting speed-dependent equivalent resistance **r2'{(1/s)-1}** goes to zero and the resistance of the rotor branch of the equivalent circuit becomes very small. Thus, the rotor current is much larger than current in the excitation branch of the circuit such that the excitation branch can be neglected. Voltage and power are measured at the motor input.

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Readings Obtained:

Line to line voltage at stator terminals : V_{br} volts

Stator Phase Current : I_{br} amps

Per phase power drawn by the stator : P_{br} watts

Calculations:

$$Z_{br} = \frac{(V_{br}/\sqrt{3})}{I_{nl}} \text{ ohms}$$

$$r_{br} = \frac{P_{br}}{I_{br}^2} = r_1 + r_2' \text{ ohms}$$

$$X_{br} = \sqrt{Z_{br}^2 - R_{br}^2} = X_1 + X_2' \text{ ohms}$$

If it is assumed that $X_1 = X_2'$, then $X_1 = X_2' = \frac{X_{br}}{2}$ ohms

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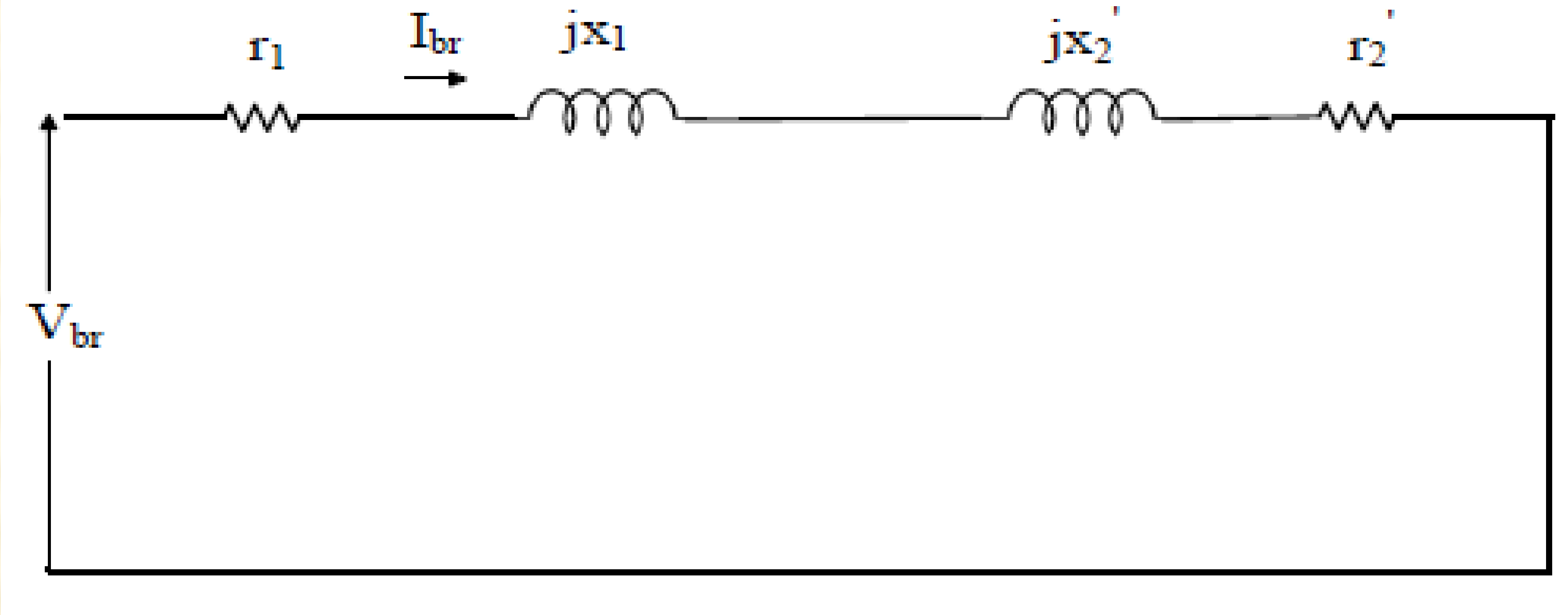

Fig. 4. Equivalent Circuit for Blocked Rotor Test

EFFICIENCY

$$\eta = \frac{P_{out}}{P_{in}} \times 100\%$$

$if\ \ P_{losses}\ are\ given,$

$$P_o = P_{in} - P_{losses}$$

$$P_o = P_m - P_{\mu}$$

$otherwise,$

$$P_{in} = \sqrt{3} V_s I_s \cos\theta$$

$$P_{out} = x\,hp \times 746W = 746x\,Watt$$