EXP. No. (1)

Determination of the Performance Characteristic of a Three Phase Induction Motor by Load Test

Theory:

The motor is run at rated voltage and frequency with electrically loaded by DC generator. For various values of the load torque, the speed, input power and input current are recorded.

1-Speed:

The speed of an induction motor as in shunt machine drops only slightly as the load is increased, the fall in speed from no-load to full-load being of the order of 5% of the rated speed. The actual speed of the motor is n_s (1-s) where s is the slip. Values of s at full-load usually lie in the range 0.02 to 0.05.

2-Power Factor:

The power factor of stator current is making up of the following components:

i- A magnetizing current to develop a rotating field, this component is purely reactive.

ii- A component to supply copper loss and stator iron loss.

iii- A component to balance the rotor current.

At no-load, the motor is required to develop power only to supply friction and wind age loss and therefore, the rotor current is very small. The magnetizing current at no-load is very large and, therefore, the input power factor at no-load is very low from (0.1-0.5).As the load on the motor increases the component of rotor current increase which is a large active component and then power factor improves. The best power factor (0.85-0.90) being obtained somewhere between 60% and 80% of full-load. Therefore, the power factor decrease slightly.

3-Effeciency:

At no-load the efficiency is zero. As the load increase, the efficiency rise and is maximum for the load at which the variable loss are equal to the fixed loss. The maximum efficiency usually lies in the range 80% for small motor to 95% for very large motors. If the load is increased beyond the point of maximum efficiency, the copper losses increase more rapidly than the output and the efficiency reduces. The loss in induction machine are fixed losses (stator copper loss. (f+w) losses and variable losses which are composed of rotor and stator copper losses and rotor iron loss). Under normal running condition the rotor iron losses are negligibly small.

4- Input current:

The no-load current is approximately (0.2 to 0.3) times full-load current. As load is increased, the current rise rapidly. After about 75% of the load, the variation of the input current with power output is linear. All induction motor above 5hp must be started through a starter. This is necessary to keep the current drawn by the motor at the instant of starting with in reasonable limits. Otherwise, the large starting currents may cause undesirable voltage drop.

Common methods for starting:

Auto transformer, star-delta and rotor resistance method.

$\mathbf{P_i=\sqrt{3}\ V_1 I_1 \cos\emptyset}$

The power factor may be calculated for every reading.

$\emptyset=\cos^{-1}\frac{Pi}{\sqrt{3}V1I1}$

The power output (P_o) of the motor

$\mathbf{P_o=\frac{2\pi nT}{60}}$

When:

n=rotor speed

T=output torque in (N.m.)

If the torque meter not available the efficiency of dc generator may be assumed.

Procedure:

1- Connect the circuit diagram as shown in figure.

2- Start the motor without load, until attained steady speed, record the applied voltage, line current, power input and speeds.

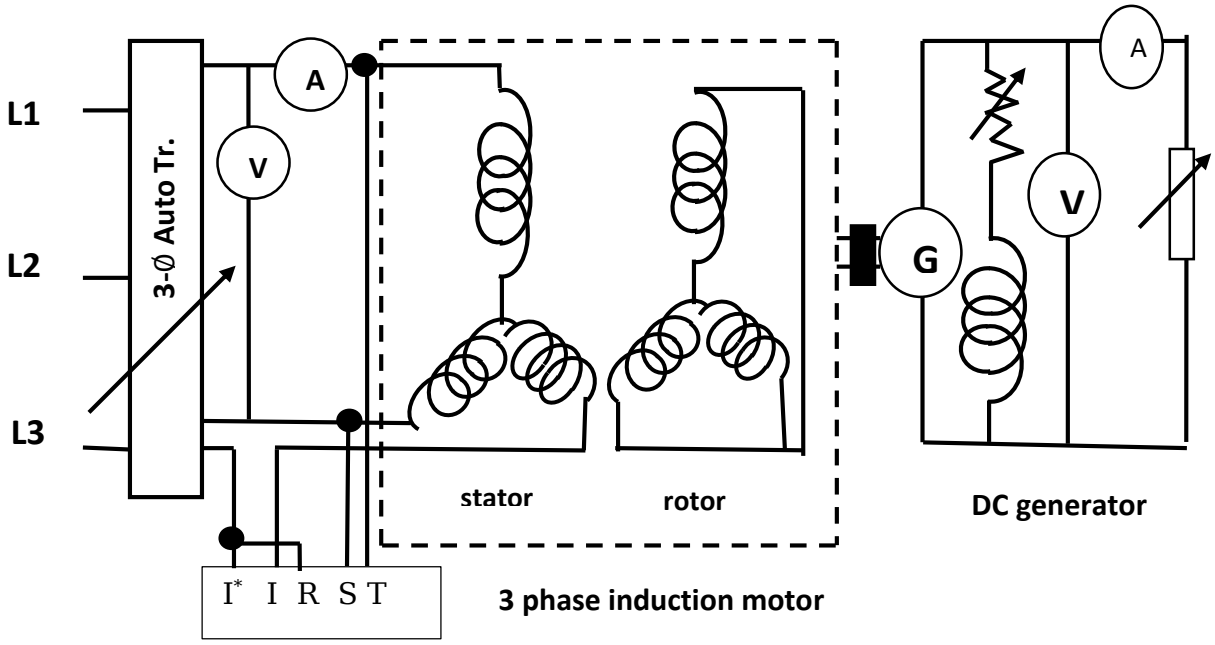
3- Gradually increase the load on the motor, and for suitably spaced value of load, record data such as in table shown. Take observation up to 120% of rated load (in the over load region the reading must be make quickly).

4- Reduce the load and stop the motor.

$\mathbf{P_oM=P_iG}$

Vi (v)	Ii (A)	Pi (w)	N (r. p.m.)	S	PF	Po (w)	η%	V dc (v)	I dc (A)	P dc (w)

----------Table---------



----------Figure----------

Report:

1- Compute from the data (torque, power input, efficiency) for every load setting as shown in table.
2- Plot the following curves on the same graph-paper:
a- Speed vs. load (I_L).
b- Cos ϕ vs. load (I_L).
c- Efficiency vs. load (I_L).
d- Input current vs. load (I_L)

3- Plot in a separate graph paper speed vs. torque (or input power of dc. generator).

Question:

1- Why does the speed of an induction motor fall as the load torque is increased?
2- Why is it necessary to start an induction motor at reduced voltage? It necessary to start an induction motor at reduced voltage?
3- Discuss various methods of starting induction motors.
4- How can the direction of I.M be reversed?