ELECTRICAL MACHINES LABORATORY

Swinburne's test is the simplest **indirect** method of testing dc machines. In this method, the **dc machine**(generator or motor) is run as a motor at no-load and losses of the machine are determined. Once the losses of the machine are known, its efficiency at any desired load can be determined in advance.

- **Speed control methods of shunt motor:**

1. Applied voltage control.
2. Armature rheostat control.
3. Field flux control.

Conclusions:

• Armature Rheostat control method and voltage control methods are useful to obtain the speed less than the rated speed.

• Among the above two methods voltage control method is preferable than Armature Rheostat control since large amount of power is wasted in the external resistance.

• Field control or Flux control method is used to obtain the speed more than the rated speed.

To obtain the performance characteristics of a DC shunt motor by load test.

1. Speed ~ Armature current

2. Torque ~ Armature current

3. Induced emf ~ Armature current

4. Torque ~ Speed

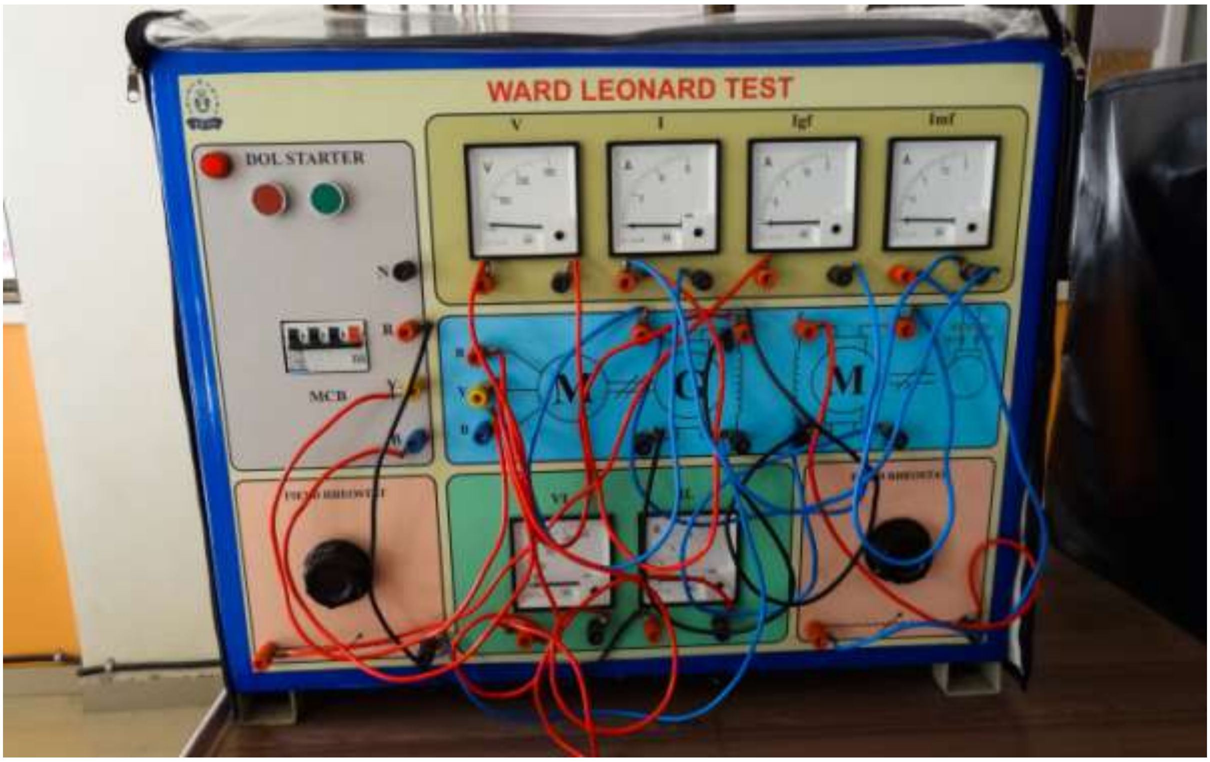
5. Output ~ efficiency

This is a direct method of testing a dc machine. It is a simple method of measuring motor output, speed and efficiency etc., at different load conditions. A rope is wound round the pulley and its two ends are attached to two spring balances S1 and S2.The tensions provided by the spring balances S1 and S2 are T1 and T2. The tension of the rope can be adjusted with the help of swivels.

Output ~ Efficiency: The graph between Output ~ Efficiency indicates that max torque occurs when armature copper losses is equal to the constant losses. (Sum of field copper losses, mechanical losses and Iron losses)

A DC motor takes electrical energy and converts into mechanical energy whereas a DC generator coverts mechanical energy into electrical energy.When used as a motor the inputs are Armature Voltage (Va) and Mechanical Load Torque (Tme).

When used as a Generator the Armature Voltage Input is set to zero and the Mechanical Torque Input is applied as Negative. The outputs will be Ia, Wr and Ea. In the case of a Generator the Load Resistance and Inductance has to be added to that of the Armature Resistance and Inductance. The speed may be fed back to control the Mechanical torque like a standard governor to model the prime mover.



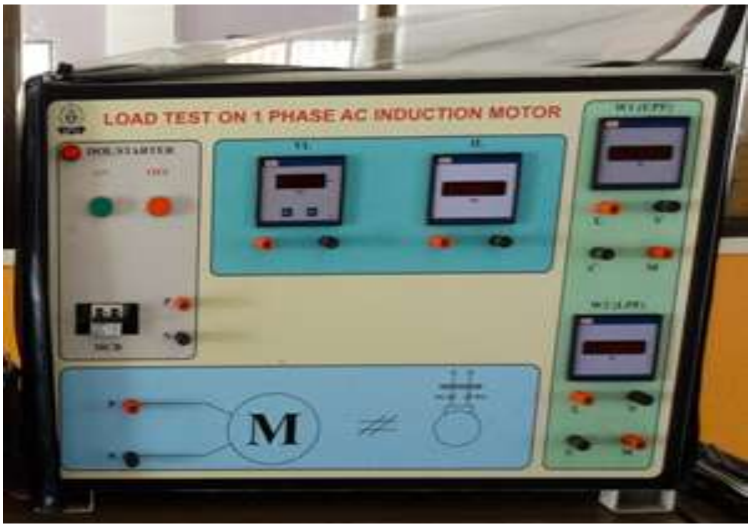
This is essentially armature voltage control of speed with constant field excitation. In this method the variable voltage to be applied to the motor armature is obtained from an additional separately excited d.c generator, and the motor under control is also run as a separately excited motor. The above equation shows that if the motor excitation is constant and the applied voltage V is varied the speed will be almost directly proportional to the armature voltage.

The system can be more adopted for forward as well as reverse operation of the motor by changing the polarity of the voltage applied to its armature. This can be achieved by reversing the direction of the field current of the separately excited variable voltage generator.

The variable voltage generator in Ward Leonard system is driven by a constant speed motor I.e a d.c shunt motor, a 3 phase induction motor or a synchronous motor.If the constant voltage d.c power for excitation is not available otherwise, the same may be obtained from a constant voltage exciter coupled with the auxiliary motor generator set. The direction of the field current of the variable voltage generator may be reversed by any one of the following two methods

1. By providing a reversing switch in the field circuit

2. By connecting two potentiometer rheostats across generator field across the movable terminals.



The **load test** on induction motor is performed to compute its complete performance i.e. torque, slip, efficiency, power factor etc. During this test, the motor is operated at rated voltage and frequency and normally loaded mechanically by brake and pulley arrangement from the observed data, the performance can be calculated using suitable equations.

No Load test is performed to determine no-load current I0, no-load power factor cos Ø0, windage and friction losses, no-load core loss, no-load input, and no-load resistance R0 and reactance X0. This test is performed with different values of applied voltage below and above rated voltage while the motor is running light (without load).

Block Rotor Test is performed to determine the short-circuit current I_{sc} with normal applied voltage to stator; power factor on short-circuit; total equivalent resistance and reactance of the motor as referred to stator. The locked rotor test is done by mechanically holding the motor shaft from turning, and applying a reduced Voltage on the stator.

Synchronization of alternator means connecting an alternator into grid in parallel with many other alternators,that is in a live system of constant voltage and constant frequency. Many alternators and loads are connected into a grid, and all the alternators in grid are having same output voltage and frequency (whatever may be the power). It is also said that the alternator is connected to infinite bus-bar. For obtaining parallel operation 'two bright and one dark method' and synchroscope is used.

A synchroscope is a device which shows the correct instant of closing the synchronizing switch. Synchroscope has a pointer which rotates on the dial. The pointer rotates anticlockwise if the machine is running slower or it rotates clockwise if the machine is running fast. The correct instant of closing syncronizing switch is when the pointer is straight upwards.

This test is performed on synchronous motor on the various excitation conditions. Such as: Under excitation, over excitation and normal excitation. From which we obtain its characteristics which are V and inverted V curves.