DEPARTMENT OF ELECTRICAL ENGINEERING
EE 19001 FIRST YEAR E.T. LAB
Experiment. NO. – 7

INDUCTION MOTOR

1. OBJECT:

i) To study the constructional features of a three phase induction motor;
ii) To plot torque-slip characteristics of the motor over the operating range;
iii) To plot power factor and efficiency curves of the motor against shaft load;

INDIVIDUALLY note the **complete** name-plate data/information of the motor/transformer that is/are required for the experiment and **obtain the signature of the teacher before the start of the experiment**. It must also be confirmed that the fuse/meter ratings being used are suitable.

2. CIRCUIT DIAGRAM:

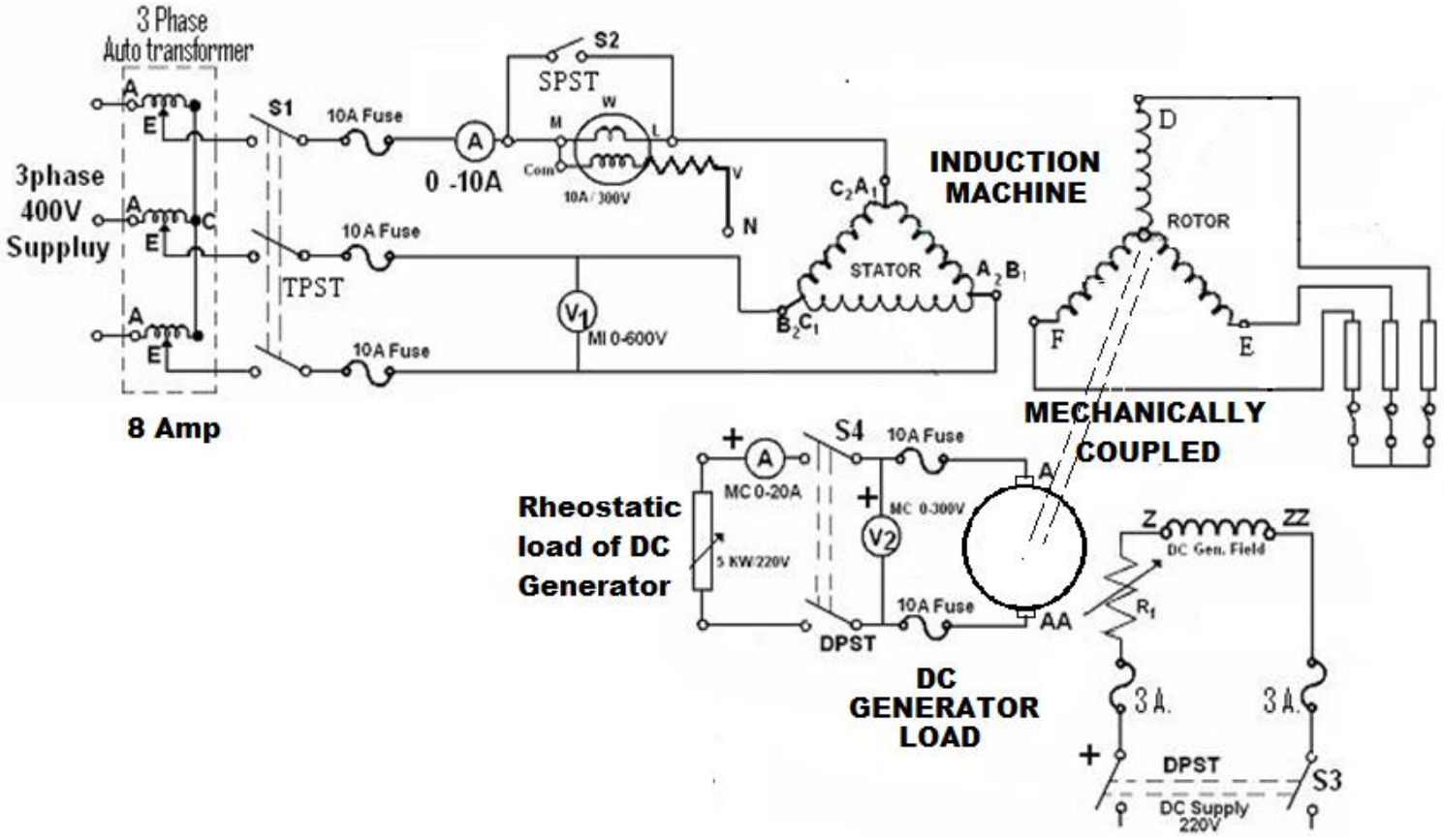

Figure 1. Circuit diagram for studies on Induction Motor

2.1 Procedure:

1. Choose the appropriate ranges of the meters and connect the induction motor (IM) only as shown in Figure 1. Keep S_1, S_3 and S_4 open **but S_2 closed. Ensure that the auto transformer is at zero output position.**
2. After switching on the circuit, slowly increase the auto-transformer output voltage **so that the motor current never exceeds the motor ratings**. Observe that this current falls off as the motor speeds up. Increase the applied voltage to rated value to check this part of the circuit.
3. Switch off the IM including all supplies and connect the DC generator part of the circuit now. Restart the IM as in step 2, above.
4. The motor is now running on no load. Open the switch S_2 and note down all the readings as per Table 1, below;
5. Keep R_f at its maximum value and close the switch S_3 to energise the field winding of the generator;
6. Adjust R_f such that rated voltage is generated across the armature of the D.C. generator - V_2 indicates the generated voltage;
7. Ensuring that all the switches of the loading rheostat **are open**, close the switch S_4;
8. Now start closing the switches of the loading rheostat one-by-one and record all the meter readings, including speed at the appropriate places in table. Note that the rated current of the induction motor should not be exceeded while closing the loading rheostat switches;
9. Repeat steps 7 and 8 for a ac supply voltage of about 80% of IM rated voltage;

2.2 Computation and plots

1. Output power of generator (DC) = $P_{e\_output} = V_2 I_2$

2. Shaft power of the induction motor, $P_{sh} = P_{e\_output} + P_o = V_2 A_2 + P_o$
   where, P_o is the constant rotational loss comprising frictional loss and core loss of the D.C. generator. Measure it with Generator on no-load. (Note: P_{sh} ignores small amount of D.C. armature copper loss but includes the IM losses);

3. Estimated shaft torque of the induction motor , $T_{sh} = (60P_{sh}) / (2\pi n_r)$
   where n_r is in rpm. Calculated slip, $s = (n_s - n_r)/n_s$

4. 3-ϕ input power to the induction motor, P_{in} = 3 x (Wattmeter reading)

5. Estimated efficiency of the induction motor, $\eta = P_{sh} / P_{in}$

6. Operating power factor of the induction motor, $\cos\theta = P_{in} / (\sqrt{3} V_1 A_1)$

[Supply frequency = 50 Hz]

Table 1

Recorded values							Calculated values			
Sl. No.	**V_1 (V)**	**A_1 (A)**	**V_2 (V)**	**A_2 (A)**	**W (W)**	**Speed (rpm)**	**Slip %**	**T_{sh}**	**cos θ**	**η_m**
1.										
2.										
3.										
4.										
5.										
6.										

Draw the following graphs:

1. Torque vs slip;
2. Power factor vs slip;
3. Efficiency vs slip

Answer the following questions:

1. How can the direction of rotation of a 3-phase induction motor be reversed?
2. What purpose do the slip rings and brush arrangement serve?
3. Explain how the induction motor gets loaded when the D.C. generator is loaded?
4. What is the effect of reduction in supply voltage on the torque and speed of the motor?
5. What happens to the running motor when fuse of one of the phases blows off?
6. Will the motor start, if fuse of one of the phases in not present?

Reference:

NAGARTH & KOTHARI: Electrical Machines.
M.G.Say: AC Machines
A.S.Langsdorf: Theory of Alternating Current Machinery
HUGHES: Electrical Technology.