**Homework 2**

**Q.1.** A series of tests are made on a 3-phase, 700kW, 690V, 4-pole, 50 Hz, Y connected, wound rotor induction machine and the following results are obtained for one phase of the motor:

Locked rotor test: P1 = 4 kW, V1 = 34 V, I1 = 250 A *(all variables are per phase)*

No load test: P1 = 4.5 kW, V1 = 400 V, I1 = 8.5 A *(all variables are per phase)*

The total rotational loss of the machine at no load test is 4.5 kW.

The DC resistance measured between two phases is: Rdc = 0.06 Ω

**Assumptions:**

* The rotational loss is constant at all operating conditions.
* Throughout the question, the shunt branch is moved to the stator terminals.
* In the equivalent circuit: X1 = X2’

1. Find all the equivalent circuit parameters of this machine.
2. Calculate the synchronous speed.
3. Calculate the slip at maximum torque.
4. Calculate the maximum torque when rated terminal voltage is applied to the machine.
5. Calculate the starting torque when rated terminal voltage is applied to the machine.
6. Plot the torque speed characteristics (all three regions) of this machine and show those points.
7. ***Increase****,* ***decrease*** *or* ***no change.***

* What happens to the maximum torque when the terminal voltage is increased?
* What happens to the maximum torque when external resistances are connected to the rotor windings?
* What happens to the starting torque when the terminal voltage is increased?
* What happens to the starting torque when external resistances are connected to the rotor windings?

1. Suppose that a constant torque load is connected to the shaft of this machine when the applied voltage is rated and the machine slip is observed as 0.05. What is the load torque? What is the rotor speed?
2. At the operating condition in (h), find the efficiency of the machine. Note that all power components should be calculated as total power (not per phase).