Modelling of Machines

Tutorial Sheet 5- Single-Phase Induction Machines

1. An electric garden tool is fitted with a four-pole single-phase induction machine. This is connected to a 230Vrms, 50Hz sinusoidal AC mains supply. The machine has the following equivalent circuit parameters (all rotor values are already referred to the stator):

Stator resistance: 9Ω

Rotor resistance: 50Ω

Stator leakage reactance: j8Ω

Rotor leakage reactance: j9Ω

Magnetising reactance X_m: j500Ω

Calculate the mechanical torque produced by the motor when it is running at 1270rpm, and hence the efficiency.

2. A four-pole single phase induction machine is connected to a 230Vrms, 50Hz sinusoidal AC mains supply. It draws a current of 1.72 Arms at a lagging power factor of 0.70 when running at 1300rpm. The machine has the following equivalent circuit parameters (all rotor values are already referred to the stator):

Rotor resistance: 46Ω

Rotor leakage reactance: j9Ω

Magnetising reactance X_m: j320Ω

Calculate the stator leakage reactance and stator resistance

Calculate the mechanical output power at this operating speed.

3. A four-pole single-phase induction machine is connected to a 110Vrms, 60Hz sinusoidal AC mains supply. The machine has the following equivalent circuit parameters (all rotor values are already referred to the stator):

Stator resistance: 2.02Ω

Stator leakage reactance: j2.79Ω

Rotor resistance: 4.12Ω

Rotor leakage reactance: j2.12Ω

Magnetising reactance X_m: j66.8Ω

For a slip of 0.05, calculate the input current, power factor, output power, speed and torque.