Induction Motors Tutorial

Q1 Determine the equivalent circuit parameters given the following test results for a 6 pole induction motor:

Locked Rotor Test:

Measurement	Value
V_{ph}	100V
I_s	5A
P_{in}	350W
R_s	6Ω

No Load Test:

Measurement	Value
V_{ph}	400V
I_s	1A
P_{in}	100W

Note: P_{in} is single phase power input (W)

Q2 A 6 pole, 3 phase, 50Hz induction motor is operating at a speed of 970rpm. The input power is 8kW and the stator copper loss is 240W. Friction and windage loss can be assumed to be zero and the iron loss is 200W. Determine the following:

(i) Slip (s)
(ii) Airgap Power (W)
(iii) Rotor copper loss (W)
(iv) Mechanical output power (W)
(v) Torque (Nm)
(vi) Efficiency (%)

Q3 Given the equivalent circuit parameters shown on Table 1, determine the following for a 3 phase 4 pole machine rotating at 1350rpm and operating off a 231V (phase voltage), 50Hz supply:

(i) Slip (s)
(ii) Airgap Power (W)
(iii) Mechanical Power (W)
(iv) Motor Torque (Nm)
(v) Total Machine Losses (W)
(vi) Motor Efficiency (%)
(vii) Input Power (W)
(viii) Input Current (I_S) and power factor

Table 1:

Parameter	Value
X_M	400Ω
R_c	1500Ω
R_s	5Ω
X_{eq}	4Ω
R_r	6Ω

Q4 A 7.5kW, 3 phase, 60Hz, 460V, star connected 4 pole machine has a full-load speed of 1764rpm. In the per-phase equivalent circuit; the Stator Resistance is 0.25Ω, the referred Rotor Resistance is 0.5Ω, the total Leakage Reactance is 2.5Ω, and the Magnetising Reactance is 60Ω. Calculate the ratio between the standstill input current and the full-load input current. What is the full-load power factor? Ignore Iron losses.