EE4001, Induction Motor Quiz

Student Name: **Student Number:**

1. A 4-pole induction generator is rated to rotate at 1824 rpm when supplied by 60 Hz electrical. What are the rotor slip frequency, f_{slip}, and the slip s?

2. The above generator develops a rated torque of 100 Nm. What is the slip if the torque drops to 50 Nm, assuming rated voltage and frequency?

3. A motor is fed by a per-phase current of 5 A rms under rated conditions. Neglecting leakages and winding resistances, what are the magnitude (rms) and phase of the new per-phase current if the torque and resultant rotor current drop in half, assuming a per-phase magnetizing current of 3 Arms?

4. A four-pole machine develops an electromagnetic torque T_{EM} of 10 Nm at a slip of 1 % when supplied by an electrical voltage of frequency 50 Hz. What are (i) the airgap power and (ii) the rotor power loss.

5. Given the following parameters for the 22 kW, 4-pole machine: L_M = 122 mH, R_R' = 0.44 Ω, R_S = 0.58 Ω, P_{CFW} = 671 W, L_{LS} = 2.9 mH, L_{LR}'= 4.3 mH. Calculate the 3-phase power measured by the meter if the measured phase current is 10.3 A during the no-load test. (04-05)

6. Based on the above parameters for the 22 kW, 4-pole machine, what is the per-phase current in the locked-rotor test when the applied voltage is 54.7 V, 50 Hz, per phase. (04-05)

7. A four-pole star-connected induction motor used in an electric vehicle application has the following per-phase equivalent circuit parameters: R_S = 11.8 mΩ, L_{LS} = 0.0972 mH, L_M = 2.0 mH, L_{LR}' = 0.0772 mH, and R_R' = 12.9 mΩ. When supplied by a current-controlled inverter outputting 93 A at 200 Hz, the motor generates an output torque of 40 Nm at 5945 rpm. Core, friction and windage losses are estimated at 2.3 kW at this speed. Determine (i) approximate values for the input per-phase voltage and per-phase current.

8. The specification table for Westinghouse induction motors is provided as an attachment. Consider the 75 kW, **eight**-pole machine with 400 V (line-line), 50 Hz applied in the delta configuration. Determine (i) the slope of the torque/speed (Nm/Hz) curve in its linear region, (ii) the per-phase magnetizing inductance, L_M, and (iii) the reflected rotor resistance, $R_R^{'}$.