EE 114 – Power Engineering I

Assignment 06

Question 1) A 3-phase induction motor having a 6-pole, star-connected stator winding runs on a 240 V, 50 Hz supply. The rotor resistance and standstill reactance are 0.12 ohm and 0.85 ohm per phase respectively. The ratio of stator to rotor turns is 1.8. The full-load slip is 4%. Calculate for this load the total developed torque and the horse power. Find also the maximum torque and the speed at maximum torque. Neglect stator impedance.

Question 2) Determine the parameters of a three-phase induction motor from the following tests:
No-load test: 400 V, 9.5 A, 1400 W
Short circuit test: 200 V, 50 A, 700 W

Question 3) A 40 horse power, 3-phase induction motor has a full-load slip of 3%. The stator losses amount to 5% of the input and the mechanical losses are 1.5% of the output. If the current in each rotor phase is 45 A, find the resistance per phase of the rotor and the efficiency of this machine.

Question 4) The induced e.m.f. for each winding of a 50 Hz 4-pole induction motor is 120 V. The number of effective turns of each winding is 120. When the motor develops a torque of 60 Nw-m, the angle between the stator m.m.f. and air gap flux is 60°. Find the magnitude of the stator m.m.f.

Question 5) A 1100 V, 50 Hz star-connected induction motor has a star-connected slipring rotor with a transformation ratio of 3.8. The rotor resistance per phase is 0.012 ohm and leakage inductance is 0.8 mH per phase. Neglect stator impedance. Find (a) the rotor starting current per phase with slip-rings short-circuited, (b) the rotor power-factor at the starting, (c) the external resistance per phase required to obtain a starting current of 100 A in the stator, (d) the rotor current at 4% slip and (e) the rotor power-factor at 4% slip.

Question 6) A 4-pole, 3-phase induction motor delivers 37 h.p. at the shaft at a speed of 1425 r.p.m on 500 V, 50 Hz supply. The mechanical losses total 3 h.p. and the power factor is 0.9. Calculate for this load (i) the slip, (ii) the rotor copper loss, (iii) the total power input if the stator losses are 2500 W, (iv) the efficiency, (v) the line current, (vi) the number of complete cycles per minute of the rotor e.m.f.

Question 7) The power input to a 3-phase, 50 Hz induction motor is 50 KW. The total stator loss is 800 W. Find the total mechanical power developed and the rotor copper losses per phase, if it is observed that the rotor e.m.f. makes 90 complete cycles per minute.

Question 8) A 8-pole, 3-phase alternator is coupled to a prime mover running at 750 r.p.m. It supplies an induction motor which has a full-load speed of 960 r.p.m. Find the number of the poles of the motor and the slip.

Question 9) The rotor resistance and standstill reactance of a 3-phase induction motor are 0.012 ohm and 0.08 ohm per phase respectively. The full-load slip is 4% at normal voltage. Calculate the percentage reduction in stator voltage to develop full-load torque at 75% of full-load speed.

Question 10) An induction motor has an efficiency of 0.85 when the load is 60 h.p. At this load, both the stator copper loss and the rotor copper loss are equal to the core-losses. The mechanical losses are one-fourth of the no-load loss. Calculate the slip.

Question 11) A 3-phase, delta-connected, 32 h.p., 480 V, 6-pole, 50 Hz induction motor gave the following test data.

No-load test: 480 V, 10 A, +1.89 KW −0.59 KW

Blocked-rotor test: 96 V, 36 A, +1.67 KW −0.07 KW

The figures given are the measurement of the line voltage and current and reading of two wattmeters connected to measure input power.

Find from the circle diagram for full-load condition (a) The line current, (b) The power factor, (c) Slip, (d) Torque, (e) Efficiency. Also find the maximum torque and starting torque of full-load torque, slip for maximum torque and the maximum power output. The rotor copper losses is equal to the stator copper loss at standstill.