

Department of Electrical Engineering
Indian Institute of Technology Bombay, Powai
EE111 : Introduction to Electrical Electrical
Assignment 7

1. If the electromotive force in the stator of an 8 pole IM has a frequency of 50 Hz, and that in the rotor is 1.5 Hz, at what speed is the motor running and at what slip?
2. A 6 pole, 50 Hz, 3-phase IM running on full load develops a useful torque of 162 Nm, and it is observed that the motor emf makes 90 complete cycles per minute. Calculate the brake horse power. If the mechanical torque lost in friction be 13.5 Nm, find the copper loss in the rotor windings, the input to motor and the efficiency. Total stator losses are 750 W.
3. A 500 V, 3-phase IM has a stator impedance of $0.062 + j0.12\Omega$. The equivalent rotor impedance at standstill is the same. The magnetizing current is 36 A, the core loss is 1500W, and the mechanical loss is 750 W. Estimate the output, efficiency and power factor at a slip of 2%.
4. An IM has an efficiency of 0.9 when the load is 50 hp. At this load, the stator copper loss and rotor copper loss each equals the iron loss. The mechanical losses are 33% of no-load loss. Calculate the slip.
5. A 6 pole 3-phase IM develops 30 hp including mechanical losses that total 2 hp at speed 950 rpm when connected to 50 Hz mains. The power factor is 0.88. Calculate for this load: (a)the slip; (b)the rotor copper loss; (c)the total input if the stator losses are 2000 W; (d)the efficiency; (e)the line current; (f)the number of complete cycles of the rotor electromotive force per minute.
6. A three-phase IM has a 4 pole star connected stator winding, and runs on 220 V, 50 Hz supply. The rotor resistance is 0.1Ω and the reactance is 0.9Ω . The ratio of stator to rotor turns is 1.75; full load slip is 5%. Calculate for this load (a)total torque (b)horse power (c)max. torque (d)speed at max. torque.

7. The power input to a 500 V, 50 Hz, 6 pole, 3 phase IM running at 975 rpm is 40 kW. The stator losses are 1 kW and the friction and windage losses total 2 kW. Calculate (a) slip; (b) rotor copper loss; (c) shaft horse power; (d) efficiency
8. On a short circuit test (blocked rotor test) a 12 pole, 3 phase, 50 Hz induction motor with an equivalent standstill rotor resistance equal to the stator resistance, took 250 A and 100 kW. Find the starting torque developed.
9. A 8 pole, 50 Hz, 3 phase induction motor has an equivalent rotor resistance of $0.07 \Omega/\text{phase}$. If its stalling speed is 630 rpm, how much resistance must be included per phase to obtain maximum torque at starting? Ignore magnetizing and core loss components of current.
10. The following results are obtained from a 3 phase, 100 hp, 460 V, 8 pole star connected squirrel cage induction motor.
No load test: 460 V, 40 A, 5.2 kW, 60 Hz.
Blocked rotor test: 100 V, 60 Hz, 140 A, 8 kW
(a) Determine the parameters of equivalent circuit; (b) The motor is connected to a 3 phase, 460 V, 60 Hz supply and runs at 873 rpm. Determine the input current, input power, air gap power, rotor copper loss, mechanical power developed, output power, and efficiency of motor. Assume stator resistance per phase = rotor resistance per phase at standstill and leakage reactance of rotor = leakage reactance of stator.
11. A 30 hp, 500 V, 4 pole, 50 Hz cage induction motor with delta connected stator takes a full load current of 33 A and has a slip of 4%. The impedance/phase is 3.5Ω . Calculate the starting current taken from the supply if the motor is started by (a) direct switching (b) star-delta starter.
12. A 3 phase, 2 pole, 10 kW, 230 V, 50 Hz, delta connected induction motor has the equivalent circuit parameters referred to the stator $R'_r = 1 \Omega$, $X'_{rl} + X_{sl} = 1 \Omega$ and negligible stator resistance. The motor is driving a load at a torque of $T_L = 33.68(N/N_s)$ Nm. Determine the speed at which the motor would run at rated terminal voltage. Neglect rotational losses.
13. Assume that the above induction motor is running at a low power factor of 0.6 and the total input is 15 kVA. It is proposed to improve the power factor to 0.8 by connecting a delta connected capacitor bank. Find the value of the capacitor per phase.