

Paper -3 Energy Efficiency in Electrical Utilities

Chapter -2 – Electric Motors

Objective Type Questions

1. The Rotating magnetic field is produced in a _____
 - a) Single- phase induction motor
 - b) Three- phase induction motor
 - c) DC series motor
 - d) All of the above
2. A 4 pole 50 Hz induction motor is running at 1470 rpm. What is the slip value?
 - a) 0.2
 - b) 0.02
 - c) 0.04
 - d) 0.4

Ans: Slip = $(N_s - N)/N_s$ $N_s = (120f)/P = (120 \times 50)/4 = 1500$ Slip (S) = $(1500 - 1470)/1500 = 0.02$

3. In a no-load test of a poly-phase induction motor, the measured power by the wattmeter consists of
 - a) Core loss
 - b) Copper loss
 - c) Core loss, windage & friction loss
 - d) Stator copper loss, iron loss, windage & friction loss
4. A 50 hp motor with a full load efficiency rating of 90 percent was metered and found to be operating at 25 kW. The percent motor load is
 - a) 75%
 - b) 50%
 - c) 60%
 - d) 25%

Ans: Input power of motor = $(50 \times 745.5)/(0.9 \times 1000) = 41.416 \text{ KW}$ Percent motor load = $(25/41.41) \times 100 = 60\%$

5. A 4-pole induction motor operating at 50Hz, with 1% slip will run at an actual speed of
 - a) 1500 rpm
 - b) 1515 rpm
 - c) 1485 rpm
 - d) None of the above

Ans: $N = N_s (1 - S) = 1500 (1 - 0.01) = 1485 \text{ rpm}$ $N_s = (120 \times 50)/4 = 1500 \text{ rpm}$

6. With Decrease in speed of the motor Capacitive kVAr -----
 - a) Increases

- b) Decreases
- c) Does not change
- d) None of the above

Ans: As the motor speed decreases Slip increases and the reactive power consumption (inductive kVAr) increases, the capacitive kVAr supplied by the capacitors increases

7. Reduction in supply voltage by 10% will change the torque of the motor by
- a) 10%
 - b) 19%**
 - c) 38%
 - d) No Change
8. One low investment to improve the Efficiency of Squirrel cage motor which operates consistently below 40% of its rated capacity is by
- a) Operating in Star mode**
 - b) Operating in Delta mode
 - c) Replace motor with Correct size
 - d) None of the above
9. A 7.5KW, 415V 14.5A 1460 rpm 3 Phase rated induction motor with full load efficiency of 88% draws 10.1A and 5.1KW of input power. The % loading of the motor is
- a) 60%**
 - b) 75%
 - c) 70%
 - d) 65%

Ans: Rated Input Power = $7.5/0.88 = 8.5\text{KW}$

Actual Input power drawn = 5.1KW % Loading = $(5.1/8.5) \times 100 = 60\%$

10. A 415V, 15KW 3 phase induction motor operates at full load 88% efficiency and 0.85 pf lagging. The current drawn by the motor is
- a) 42.5 A
 - b) 48.32 A
 - c) 40 A
 - d) 27.9 A**

Ans: Input Power = $15/0.88 = 17.045\text{ KW}$ Current drawn = $17.045 / (\sqrt{3} \times 415 \times 0.85) = 27.9\text{A}$

11. Stator phase resistance at 30°C is 0.264 Ω. At 120°C its value will be
- a) 0.264 Ω
 - b) 0.354 Ω**
 - c) 0.237 Ω
 - d) None of the above

Ans: $R_2/R_1 = (235 + t_2) / (235 + t_1) = 0.264 \times (355/265) = 0.354\Omega$

12. KW rating indicated on the name plate of an induction motor indicates

- a) Rated input of the motor
- b) Rated output of the motor
- c) Maximum input power the motor can draw
- d) Maximum instantaneous input power of the motor

13. Select the incorrect statement:

- a) Harmonics occur as spikes at intervals which are multiples of the supply frequency
- b) Harmonics are multiples of the fundamental frequency
- c) Induction motors are the major sources of harmonics
- d) Transformers operating near saturation level create harmonics

14. Hydrodynamic principle for speed control is used in

- a) DC drives
- b) Fluid Coupling
- c) Pulse width Modulation
- d) Eddy current drives

15. In an Induction motor magnetic field is established in

- a) Stator winding only
- b) Rotor winding only
- c) Stator & Rotor winding
- d) None of the above

16. The slip of a synchronous motor will be

- a) More than the induction motor
- b) Less than the induction motor
- c) Zero
- d) Load dependent

17. The power factor of a squirrel cage induction motor

- a) Decreases at low motor loading
- b) Decreases at high motor loading
- c) Remains constant and is independent of load
- d) Cannot be predicted

18. In an induction motor the loss which is independent of motor load

- a) I^2R loss of stator
- b) I^2R loss of rotor
- c) Friction and windage loss
- d) All of the above

19. The voltage unbalance in three phase supply is 1.5 %. If the motor is operating at 100 °C, the additional temperature rise in °C due to voltage unbalance is

- a). 4.5
- b). 9
- c). 0
- d). None of the above

Ans: $\text{Temp Rise} = 2 \times (\% \text{ Voltage Unbalance})^2 = 2 \times 1.5^2 = 4.5$

20. Which parameters need to be measured to assess the percentage loading of a motor by slip method neglecting voltage correction?

- a) Motor speed
- b) Synchronous speed
- c) Operating motor speed and frequency
- d) Operating current

21. The performance of rewinding of an induction motor can be assessed by which of the following factors?

- a) No load current
- b) Stator resistance per phase
- c) Load current
- d) Both no load current and stator resistance per phase

22. An induction motor rated for 75 kW and 94 % efficiency, operating at full load, will

- a) Deliver 70.5 kW
- b) Deliver 75 kW
- c) Draw 75 kW
- d) Deliver 79.78 kW

Ans: Rating indicates Rated Output of the motor

23. Which loss is considered the most unreliable or complicated to measure in electric motor efficiency testing?

- a) Stator Cu loss
- b) Rotor Cu loss
- c) Stator Iron loss
- d) Stray loss

24. A 22 kW, 415 V, 45A, 0.8 PF, 1475 RPM, 4 pole 3 phase induction motor operating at 420 V, 40 A and 0.8 PF. What will be the rated efficiency

- a) 85.0%
- b) 94.5%
- c) 89.9%

d) 88.2%

Ans: Input Power = $\sqrt{3} \times 415 \times 45 \times 0.8 = 25.876 \text{KW}$ Rated output power = 22KW

Efficiency = $(22/25.876) \times 100 = 85\%$

25. Star – delta starter of an induction motor

- a) Reduces voltage by inserting resistance in rotor circuit
- b) Reduces voltage by inserting resistance in stator circuit
- c) Reduces voltage through a transformer
- d) Reduces the supply voltage due to change in connection configuration



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Website: www.greentechlearning.com
Mailid: greentechlearningsolutions@gmail.com
Mobile: +919037502805