UNIT IV
STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR
PART A

1. What is the need of starter for induction motor?

The plain induction motor is similar in action to polyphase transformer with a short-circuited rotating secondary. Therefore, if normal supply voltage is applied to the stationary motor, then, as in case of a transformer, a very large initial current about 5-7 times full load current is drawn taken by the stator.

2. What is the magnitude of starting current & torque for induction motor?

Induction motors, when direct-switched take five to seven times the full load current and develop only 1.5 to 2.5 times their full- load torque.

3. What is the relationship between staring torque and full load torque of DOL Starter?

Tst / Tf = (Isc/If)2. sf

4.Name the different types of starters used for induction motor.

- Primary resistor
- Autotransformer starter
- Star-delta starter
- Rotor rheostat

4. What are the advantages of primary resistance starter of induction motor?

- Starting torque to full load torque is x2 of that obtained with direct switching or across the line starting.
- This method is useful for smooth starting of small machines only.

5. What are the advantages of autotransformer starter?

- Reduced voltage is applied across the motor terminal.
- There is a provision for no-voltage and over-load protection.

6. Brief the over –load protection of autotransformer starter.

When the load on the motor is more than the rated value the supply to motor will be cut off.

7. Give the relationship between starting current and full load current of autotransformer starter.

I2 = K. Isc where K is transformation ratio.

8. How the induction motor is started using star-delta starter?

The motor is connected in star for starting and then for delta for normal running.

9. Give the relationship between starting torque and full load torque of induction motor.

Tst / Tf = 1/3. a2 . sf

10. How much time starting current is reduced in induction motor when it is connected in star?

The line current is reduced to $1/\sqrt{3}$ times of delta connected.

11. Give the relationship between starting torque of induction motor with autotransformer starter and star delta starter

Star delta switch is equivalent to an autotransformer of ratio 58% approximately.

12. How the starting current is reduced using rotor resistance starter.

The controlling resistance is in the form of a rheostat, connected in star. The resistance being gradually cut-out of the rotor circuit as the motor gathers speed. Increasing the rotor resistance, not only in the rotor current reduced at starting, but at the same time starting torque is also increased due to improvement in power factor.

13. **Mention the methods of speed control on stator side of induction motor**

- By changing the applied voltage
- By changing the applied frequency
- By changing the number of stator poles.

14. Mention the methods of speed control from rotor side of induction motor.

- Rotor rheostat control.
- By operating two motors in concatenation or cascade.

- By injecting an e.m.f in the rotor circuit.

15. Why speed control by changing the applied voltage is simpler? Explain.

- A large change in voltage is required for a relatively small change in speed.
- This large change in voltage will result in a large change in the flux density

There by seriously disturbing the magnetic conditions of the motor.

16. What are the limitations of speed control of induction motor by changing the supply frequency?

This method could only be used in cases where the induction motor happens to be the only load on the generators.

17. What are the applications of speed control of induction motor by pole changing method?

- Elevator motors
- Traction motors
- Small motors driving machine tools.

18. How the speed control is achieved by changing the number of poles.

Synchronous speed of induction motor could also be changed by changing the number of stator poles. This change of number of poles is achieved by having two or more entirely independent stator windings in the same slots.

19. What are the limitations of rotor rheostat speed control of induction motor?

- With increase in rotor resistance, I2R losses also increase which decrease the operating efficiency of the motor. In fact, the loss is directly proportional to the reduction in the speed.
- Double dependence of speed, not only on R2 but also on load as well.

20. Mention the three possible methods of speed control of cascaded connection of induction motor.

- Main motor may be run separately from the supply
- Auxiliary motor may be run separately from the mains.
- The combination may be connected in cumulative cascade.

21. How the tandem operation of induction motor start?

When the cascaded set is started, the voltage at frequency f is applied to the stator winding of main motor. An induced emf of the same frequency is produced in main motor (rotor) which is supplied to the auxiliary motor. Both the motors develop a forward torque. As the shaft speed rises, the rotor frequency of main motor falls and so does the synchronous speed of auxiliary motor. The set settles down to a stable sped when the shaft speed become equal to the speed of rotating field of Auxiliary motor

22. Brief the method of speed control by injecting emf in the rotor circuit.

The speed of an induction motor is controlled by injecting a voltage in the rotor circuit. It is necessary for the injected voltage to have the same frequency as the slips frequency

23. What are the advantages of slip power scheme?

Advantages

- Easier power control.
- Higher efficiency.

Disadvantages

- Reactive power consumption.
- Low power factor at reduced speed.

24. Mention types of slip power recovery schemes.

- Scherbius system.
- Kramer drive.

25. What is effect of increasing rotor resistance in starting current and torque?

Staring current can be reduce and starting can be increase by increasing the rotor resistance of an induction motor.

26. Why are most of the three phase induction motors constructed with delta connected stator winding?

Squirrel cage induction motor started with star to delta starter, therefore stators winding in delta connection.

28.What is meant by slip power recovery scheme?

Some amount of power is wasted in the rotor circuit .wasted power is recovered by using converter.

29. How the speed control is achieved by changing the number of poles.

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PART B

1. With neat diagrams explains the working of any two types of starters used for squirrel cage type 3 phase induction motor.
2. Discuss the various starting methods of induction motors.
3. Explain the different speed control methods of phase wound induction motor.
4. Explain the various schemes of starting squirrel cage induction motor.
5. Explain the speed control of 3 phase squirrel cage induction motor by pole changing.
6. Describe with a neat sketch, the principle and working of a star – delta starter and auto transformer starter.
7. Explain briefly the various speed control schemes of induction motors.
8. Explain in detail the slip power recovery scheme.
9. Explain the various techniques of speed control of induction motor from rotor side control.
10. Explain the cascade operation of induction motors to obtain variable speed.
11. Describe a starter suitable for a three phase slip ring induction motor.
12. Explain the speed control of -3 phase wound rotor induction motor by the rotor resistance method