**UNIT-III**

1. What are types of 3- phase induction motor?

i. Squirrel cage induction motor ii. Slip ring induction motor

2. Why the rotor slots of a 3-phase induction motor are skewed?

The rotor slots of a three -phase induction motor are skewed

i. to make the motor run quietly by reducing the magnetic hum ii. to reduce the locking tendency of the rotor

3. Why the induction motor is called asynchronous motor?

Since the induction motor runs always at a speed lesser than synchronous speed, it is called asynchronous motor.

4. What are slip rings?

The slip rings are made of copper alloys and are fixed around the shaft insulating it. Through these slip rings and brushes the rotor winding can be connected to external circuits.

5. State the difference between slip ring rotor and cage rotor of an induction motor?

Slip ring rotor has 3-phase windings. Three ends of which are stared and the other three ends are brought up and connected to 3 slip rings mounted in the shaft. Extra

resistance can be added in the rotor circuit. Squirrel cage rotor has short-circuited copper bars.

Extra resistance can't be added as slip ring rotor.

6. Write an expression for the slip of an induction motor.

Percentage slip = (Ns -Nr) / Ns * 100.

7. What is cogging of an induction motor?

When the number of stator and rotor teeth's is equal or integral multiple of rotor teeth

,they have a tendency to align themselves exactly to minimum reluctance position. Thus the rotor may refuse to accelerate. This phenomenon is known as cogging.

8. Explain why the no load current of an induction motor is much higher than that of an equivalent transformer.

In induction motor, due to the presence of the air gap, the magnetizing current that is required to set up the flux is much higher. The working component of the current has to meet the hysteresis

loss, eddy current loss, friction and windage losses. Hence the no load current of induction motor is higher.

9. State the effect of rotor resistance on starting torque?

Starting torque increases with increase in value of rotor resistance.

10. What are the advantages of cage motor?

Ø Since the rotor has very low resistance, the copper loss is low and efficiency is high

Ø On the account of simple construction of rotor, it is mechanically robust.

Ø Initial cost is less.

Ø Maintenance cost is less.

Ø Simple stating arrangement



11. Give the conditions for maximum torque for 3-phase induction motor?

The rotor resistance and rotor reactance should be equal for developing maximum torque i.e. R2 = s X2 where s is the slip –under running conditions.

R2 = X2 under starting conditions

12. What is reason for inserting additional resistance in rotor circuit of a slip ring induction

motor?

Introduction of additional resistance in the rotor circuit will increase the starting torque as well as running torque. Also it limits the starting current, improves the power factor.

13. List out the methods of speed control of cage type 3-phase induction motor?

a) By changing supply frequency

b) By changing the number of poles

c) By operating two motors in cascade

14. Mention different types of speed control of slip ring induction motor?

a) By changing supply frequency

b) By changing the number of stator poles c) By rotor rheostat control

d) By operating two motors in cascade

15. What are the advantages of 3-phase induction motor?

a) It was very simple and extremely rugged, almost unbreakable construction b) Its cost is very low and it is very reliable

c) It has been suffiently high efficiency .No brushes are needed and hence

frictional losses are reduced

d) It requires minimum of maintenance.

16. What does crawling of induction motor mean?

Squirrel cage type, sometimes exhibit a tendency to run stably at speeds as low as

1/7 the of their synchronous speed, because of the harmonics this phenomenon is known as crawling



17. State the application of an induction generator?

a) Used in windmill for generating electric power.

b) Used in regenerative breaking places like traction.

18. Name the two windings of a single-phase induction motor.

I. Running winding ii. Starting winding.

19. What are the various methods available for making a single-phase motor self-starting?

I. By splitting the single phase into 2 phases ii. By providing shading coil in the poles.

20. What is the function of capacitor in a single-phase induction motor?

I. To make more phase difference between the starting and running winding. ii. To improve the power factor and to get more torque.

21. Give the names of three different types of single-phase motor.

I. Split phase motor

ii. Shaded pole motor.

iii. Single phase series motor. iv. Repulsion motor.

22. What is the use of shading ring in a pole motor?

The shading coil causes the flux in the shaded portion to lag behind the flux in unshaded portion of pole. This gives in effect a rotation of flux across the pole face and under the influence of this moving flux a stating torque is developed.

23. State any four use of single-phase induction motor.

Fans, Wet grinders, Vacuum cleaners, small pumps, compressors, drills

24. Why is the efficiency of a 3-phase induction motor less than of a transformer?

In induction motor, there is a mechanical loss due to the rotation of the rotor. Hence the efficiency of an induction motor is less than that of the transformer.

25. What are the types of starters?

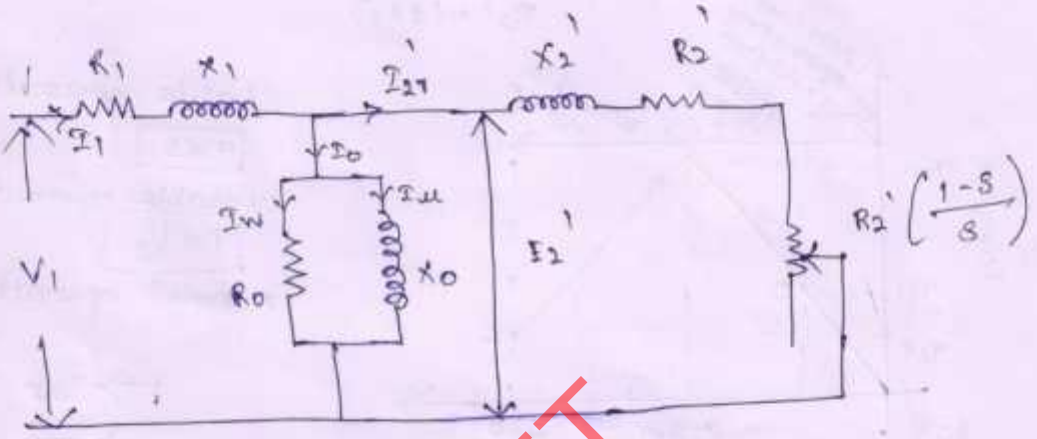
Stator rheostat, Autotransformer and Star to Delta switch

Rotor resistance starter.

# UNIT-3

## 3φ Induction motor

1. Deduce the equivalent circuit of the 3-φ Induction motor?




$$I_{2r} = \frac{SE_2}{\sqrt{R_2^2 + (SX_2)^2}} = \frac{E_2}{\sqrt{\left(\frac{R_2}{S}\right)^2 + X_2^2}}$$

$$K = \frac{E_2}{E_1} \qquad I'_{2r} = K I_{2r} = \frac{KSE_2}{\sqrt{R_2^2 + (SX_2)^2}}$$

$$E_2' = \frac{E_2}{K}$$

$$X_2' = \frac{X_2}{K^2} \qquad R_2' = \frac{R_2}{K^2}$$

$$R_1' = R_2'\left(\frac{1-S}{S}\right)$$

2. How is the circle diagram useful for estimating the working conductions of an induction motor?

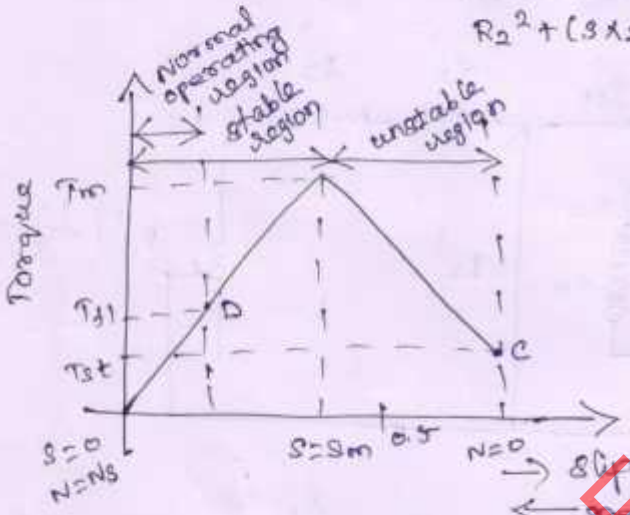
circle diagram

procedure

8) Sketch & explain the torque - slip characteristics of a 3ϕ cage & slip ring induction motors. Show the stable region in the graph.

$$T \propto \frac{s E_2^2 R_2}{R_2^2 + (sx_2)^2}$$

Explanation




Stable operating region
$T \propto S$
unstable operating region
$T \propto 1/s$
Normal operating region

→ $T_{st}$
→ $T_m$
→ $T_{fl}$



b) explain the tests required to be performed to obtain the data for the circle diagram.

No load Test
Blocked rotor test

[Diagram Explanation]

No load test :-

$$W_{NL} = W_1 + W_2$$

$$W_o = \frac{W_{NL}}{3}$$

$$\cos\phi_o = \frac{W_o}{V_o I_o}$$

$$I_w = I_o \cos\phi_o$$

$$I_\mu = I_o \sin\phi_o$$

$$R_o = \frac{V_o}{I_w}$$

$$x_o = V_o / I_\mu$$

## Blocked Test :-

$$Z_{01} = \frac{V_b}{I_b}$$

$$R_{01} = \frac{W_b}{I_b^2}$$

$$X_{01} = \sqrt{Z_{01}^2 - R_{01}^2}$$

$$R_2' = R_{01} - R_1$$

$$X_1 = X_2' = \frac{X_{01}}{2}$$

$$R_1' = R_2' \left(\frac{1}{s} - 1\right)$$

3. Explain about crawling & cogging.

## Cogging

When the number of rotor slots is equal to the stator slots, precisely the same order harmonics are strongly produced, all rotating at corresponding speeds in both stator & rotor.

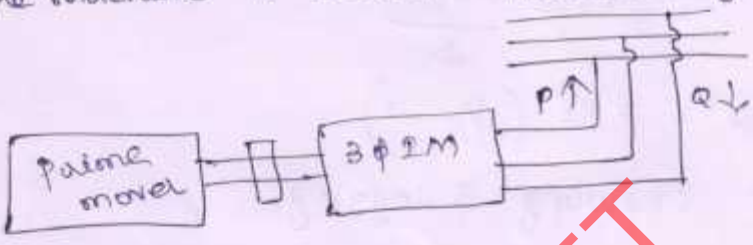
Thus, harmonics of every order would try to exert syn. torques at their corresponding synchronous speed & the motor would refuse to start. i.e., magnetic locking b/w the stator & rotor slots. This is known as cogging or magnetic locking.

## Crawling :-

The tendency of the motor to run stably at speeds as low as one seventh of its synchronous speed with its low pitched howling sound is called crawling.

4. Explain the operation of Induction Generator & Synchronous Induction motor

IG → The induction motor connected to a constant voltage, constant frequency supply is able to run only at subsynchronous speeds. Suppose the rotor is to be driven by another machine at above syn. speed, the Induction motor runs as a generator. Such arrangement of the machine is called Induction generator.




Explanation

Synchronous IM :-

A 3φ slip ring IM runs at constant speed when its rotor winding is fed from a DC source. Such motors are then called synchronous IM.

[Diagram, explanation]