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Class:

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Subject:

Electrical  
Machine

Submitted:

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Q. No 1

write introduction  
Advantage, disadvantage and  
construction of three  
Phase Induction Motor?

Ans Introduction:-

The Popularity of  
3-Phase induction motor on board  
ships is because of  
their simple, robust construction  
and high reliability factor  
in the sea environment. A  
three Phase induction motor  
can be used for different  
application with various speed  
and load requirement. Electric  
motor can be found in  
almost every Production Process  
today.

Getting the most  
out of your application is  
becoming more and more



important in order to ensure cost effective operation the 3 Phase induction motor are the most widely used electric motor in industry. They run at essentially constant speed from no-load to full-load. However,

The speed is frequency dependent and consequently these motor are not easy adapted to speed control, we usually prefer D.C motor when large speed variation are required. Nevertheless.

The 3-Phase induction motor are simple and low priced easy to maintain and can be manufactured with characteristics to suit most industrial requirement, like any electric

motor  
A 3-phase induction motor has a stator and a rotor. The stator carries a 3-phase winding while the rotor carries a short circuited winding only. The stator winding is fed from 3-Phase supply. The rotor winding derives its voltage and power from the externally energized stator winding through electromagnetic

The induction motor may be considered to be a transformer with a rotating secondary and it can therefore be described as a transformer type AC Machine in



in which energy is converted into mechanical energy.

### Advantage:-

★ It has simple and rugged construction.

★ It is relatively cheap.

★ It requires little maintenance.

★ It has high efficiency and reasonably good Power factor.

It has self-starting torque.

### Disadvantage:-

★ It is essentially a constant speed motor and its speed cannot be changed easily.

★ Its starting torque is inferior to start motor.



## Construction :-

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The 3-Phase induction motor is the most widely used electrical motor.

- In three phase induction motor the power transferred from stator to rotor winding through induction

The induction motor as it run at a speed other than synchronous speed,

like any other motor induction motor have 2 main parts namely rotor and stator. A

3-Phase induction motor has two main parts.

Stator and rotor. The rotor is separated from the

stator by a small air gap which ranges from

0.4mm to 4mm depending



on the Power of motor  
\* shaft for transmitting the  
torque to the load. This  
shaft is made up of steel  
\* Bearings for supporting the  
rotating shaft.  
\* one of the problems with  
electrical motor is the  
Production of heat during  
its rotation. In order to  
overcome this problem we  
need for cooling.

For receiving external  
connection terminal box is  
needed.



Q No : 2

write operation Principal  
of 3-Phase induction motor:

Ans: =

In an AC motor there are rings of electromagnets arranged around the outside which are designed to produce a rotating magnetic field. Inside the stator there's a solid metal cage a loop of wire a coil a squirrel cage made of metal bars and interconnection or some other freely rotating metal part that can conduct electricity. Unlike in a DC motor where you send power to the inner rotor in an AC motor you send power to the outer coil that make up the stator.



The coil are energized in pair in sequence producing a magnetic field that rotates around the outside of the motor the rotor suspended inside the magnetic field in an electrical conductor. The magnetic field is constantly changing so according to the law of electromagnetism the magnetic field produce an electric current inside the rotor of the conductor is simply a solid piece of metal eddy current swirl around it instead. Either way the induced current produce its own magnetic field and according to another law of electromagnetism to stop whatever it is that causes it the rotating magnetic field - by rotating as well.



Electromagnetic induction is the key to why a motor like this spins and that's why it's called an induction motor. An electrical circuit converts electrical energy into mechanical energy which is then supplied to different types of load.

### AC-motor

operation on A.C supply and they are classified into synchronous single phase and 3-phase induction and special purpose motor. out of all the 3 phase induction motor are most widely use for industrial application - because they do not required a starting device 3-phase induction motor device derives its name from the fact that the rotor current is



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is induced by the magnetic field instead of electrical connection.

The operation Principle of a three Phase induction motor is based on the Production of rotating magnetic field.

Q. No :- 3:

Discuss different type of starter for three Phase induction motor.

There are many method in use to start 3-Phase induction motor. Some of the common method are.

- i) Direct on line starter
- ii) star Delta starter.
- iii) Auto transformer Starter.
- iv) Rotor impedance Starter.

## Direct On-line starter:-

The direct On-line starter is the simplest and the most inexpensive of all starting methods and is usually used for squirrel cage induction motor. It directly connects the contacts of the motor to the full supply voltage. The starting current is very large, normally 6 to 8 times the rated current. The starting torque is likely to be 72 to 2 times the full load torque. In order to avoid excessive voltage drops in the supply line due to high starting currents, the DOL starter is used only for the motors with a rating of less than 5kW. There are safety mechanisms inside the DOL starter which provides protection to the



motor as well as the operator  
of the motor. The power and  
control circuits of induction motor  
with DOL starter and the real  
picture of contactor.

The DOL starter consists  
of a coil operated contactor K<sub>EM</sub>  
controlled by start and stop push  
buttons. On pressing the start push  
button S<sub>1</sub>, the contactor coil K<sub>EM</sub> is  
energized from line V. The 3 main  
contacts are closed. The motor is  
thus connected to supply.

when the stop push  
button S<sub>2</sub> is pressed. Since the  
K<sub>EM</sub> is de-energized, the main contact  
are open. The supply to motor is  
disconnected and the motor stop.

## Star-Delta Starter :-

The star-delta  
starting is very common type of

of starter and extensively used, compared to the other types of the starters. This method used reduced supply voltage in starting.

The method achieved low starting current by first connecting the stator winding in star configuration, and then after the motor reaches a certain speed, there switch change the winding arrangement from star to delta configuration.

By connecting the stator windings first in star and then in delta, the line current drawn by the motor at starting is reduced to one-third as compared to starting current with the windings connected in delta.

At the time of starting when the stator windings are star connected, each stator phase get voltage  $V_L/\sqrt{3}$ , where  $V_L$  is



the line voltage.

Since the torque developed by an induction motor is proportional to the square of the applied voltage, star-delta reduced the starting torque to one-third that obtainable by direct delta starting.

## Auto Transformer starter:-

The operational principle of auto transformer method is similar to the star-delta starter method. The starting current is limited by reduce the initial start applied voltage. The auto transformer starter is more expensive, more complicated in operation and bulkier in construction when compared with the star-delta starter method.

But an auto transformer starter is suitable for both star and delta connected motors.

and the starting current and torque can be adjusted to a desired value by taking the correct tapping from the auto transformer. When the star-delta method is considered, voltage can be adjusted only by factor.

of  $\frac{1}{\sqrt{3}}$ .

It can brief operation of auto transformer as:

- Operated by a tap position switch i.e. using a timer to change over from start to run position.
- In starting position supply is connected to stator winding through an auto-transformer which reduced applied voltage to 50, 60 and 70% of normal value depended on tapping used.
- For an induction motor, torque  $T$  is developed by  $V_a$ . Thus on 50% tapping, torque



at starting is only  $(0.5V)^2$  of the obtained by DOL starting. Hence 25% torque is produced.

- starters used in large industries, it is larger in size and expensive.

- switching from start to run positions causing transient current, which can be greater in value than those obtained by DOL starting.

## Rotor Impedance starter:-

This method allows external resistance to be connected to the rotor through slip rings and brushes. Initially, the rotor resistance is set to maximum and is then gradually decreased as the motor speed increases, until it becomes zero. The rotor impedance starting mechanism is usually very bulky and expensive when compared with other methods. It also has

very high maintenance costs. Also a considerable amount of heat is generated through the resistors when current flows through them. The starting frequency is also limited in this method.

However, the rotor impedance method allows the motor to be started while on load. This will decrease the starting current, increase the starting torque also improves the power factor. At the time of starting of the motor, the entire external resistance is added in the rotor circuit.

Then the external rotor resistance is decreased in steps as the rotor speeds up.

However the motor torque remain maximum during the acceleration period of the motor. Under normal condition when the