# Question No=01

## "Three Phase induction Motor"

Introduction:-

The Popularity of 3-Phase induction motors on board ships is because of these simple robust construction, and high reliability factor in the sea environment. A 3-Phase induction motor can be used for different applications with various speed and load requirements. Electric motors 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 insure cost effective operations. The three-Phase induction motors are the most widely used electric motors in industry. They run at essentially constant speed

from on-load to full-load. However, the speed is freveny department and consiquently these motors are not easily adopted to speed contod. we usually Prefer d.c motors when lage speed variations are reqwired Nevertheless, the 3-Phase induction motors are simple, rugged, low-Priced, easy To maintain and can be manufactured with characteristics to suit most industrial reVuirements. Like any electric moter, a 3-Phase induction moter

The stator carries a 3-Phase winding (called stator winding) while the rotor carries a short-circuted winding (called rotor winding). Only the stator winding is fed from 3-Phase supply.

The rotor winding through electromagnetic induction and hence the name. The induction motor may be considered to be a transformer with a rotating secondary and it can, therefore, be described as a "transformer Type" a.c Machine in which electrical energy is converted into mechanical energy.

**Advantages:-**

i) It has simple and rugged construction.
ii) It is relatively cheap.
iii) It requires little maintenance.
iv) It has high frevency and resonably good Power factor.
v) It has self starting starting.

**Disadvantages:-**

i) It is essentially a constant speech motor and its speed cannot be changed easily.
ii) It starting torque is inferior to d.c shunt motor

## Construction:-

The three Phase induction motor is the most widely used electrical motor. Almost, 80% of the mechanical Power used by industries is provided by three Phase induction motor because of its simple and rugged construction, low cost, good operating characteristics, absence of commutator and good speed regulation. In three Phase induction motor the Power is transferred from stator to rotor winding through induction. The induction motor is also called synchronius motor as it runs at a speed other then the synchronous speed.

Like any other electrical motor induction motor also have two main parts namely rotor and stator. A 3-Phase induction

motor have two main Parts;
(i) rotor and (ii) Stator. 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. The main body of the induction motor comprises of Two major Parts as shows:

i) Shaft for Transmitting the torque to the load. The shift is made up of steel.
ii) Bearings for supporting the rotating shaft.
iii) One of the Problem with electrical motor is the Production of heat during its rotation. In order to overcome This Problem we need fan for cooling.
iv) For recieving electrical connection Terminal box is needed.
v) There is a small distance between rotor and stator which

usually various from a1mm to 4mm. Such a distance is called air gap.

## Question No: 02

### Operational Principal :

Unlike toys and flashlights, most homes, offices, factories and other buildings aren't powered by little batteries; they're not supplied with DC current, but with alternating current (AC) which reverses its direction about 50 times per second (with the frequency of 50Hz). If you want to run a motor from your household AC electricity supply, instead of form a DC battery, you need a different design of motor.

In an AC motor, there's ring of electromagnetic arranged

around the outside (making up the stator) which are designed to produce a rotating magnetic field. Inside the stator, there's a solid metal axle, a loop of wire, a coil, a squirrel cage made of metal bars and interconnections (like the rotating cages people sometimes get to amuse pet mice), or some other freely rotating metal parts that can conduct electricity. Unlike in a DC motor, where you send power to the outer coils that make up the stator. The coils are energized in pairs, in sequence, producing a magnetic field that rotates around the outside of the motor. The rotor suspended inside the magnetic field, is an electrical conductor. The magnetic field is constantly changing (because it's

rotating) So, according to the laws of electromagnetism (Faraday's law, to be precise), the magnetic field produces or (induces. To use Faraday's own term) an electric current inside the rotor. If the conductor is ring or a wire, the current flows around it on a loop. If the conductor is simply a solid piece of metal, eddy currents swirl around it instead. Either way, the induced current produces its own magnetic field and, according to another law of electromagnetism (Lenz's law) tries to stop whatever it is that caused it - The rotating magnetic field by rotating as well. (You can think of the rotor frantically trying to "catch up" with the rotating magnetic field in an

effort to eleminate the difference in motion between them :)
Electromagnetic induction is the key to why a motor like this spins and that's why it's called an induction motor. An electrical converts electrical energy into mechanical energy which is then supplied to different types of loads Ac motors operated on Ac supply, and they are classified into synchronous, single Phase and three Phase induction motors are most widely used for industrial applications manly because they do not require a starting device, three Phase induction motor derives its name from the fact that the rotor current is induced by the magnetic field, instead of electrical connection - The operation Principal of a three Phase induction

motors is based on the production of rotating magnetic field

## Question No. 03

is Direct on-Line stator :- (DOL)

The direct on-line stator (DOL) is the simplest and the most expensive of all starting methods and usually used for squired cage induction motors. It directly connect 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 0.75 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 stator is used only for motors with

a rating of less then 5kW. There are safety mechanisms inside the (DOL) stater which provides protection To the motor as well as the operator of the motor. The power and control circuits of induction motor with (DOL) stater and the real picture of contactor The DOL stater consist of coil operated contator KIM controlled by start and stop push buttons. on pressing the start push buttons. S1, the contactor coil KIM is energized from Line L1. The three main contacts (1-2)(3-4) and (5-6) are closed. The motor is thus connected to the supply. When the STop push buttons S2 is pressed, the supply through the contactor KIM is disconnected. Since the KIM is de-energized

the main contacts (1-2) (3-4) and (5-6) are opened. The supply to motors is disconnected and the motor stops.

**Star - Delta Stator:-**

The Star delta starting is a very common type of starter and extensively used, compared to other types of the starters these method used reduced supply voltage in starting. the conneotion of a three Phase induction motor with a star delta starter. The method achived low starting current by first connecting the stater winding in Star configuration, and then after the motor reaches a certain speed, Throw switch changes the winding arrangements from star to delta configuration. By connecting the stator windings, First install and then in delta,

The light current drawn by the motor at starting is reduced to one third as compared to starting current with the windings connecting in delta. At the time of starting when the stator windings are start connecting, each stator phase gets 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 applied voltage, star-delta starting reduce the starting torque to one third that obtainable by direct delta starting.

iii) **Auto Transformer Stator:-**

The operation principle of auto transformer method is similar to the star-delta method. The starting current is limiting by (using a three phase auto transformer) reduced

The initial stator 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 stator is suitable for both star-delta and 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 be factor of $1/\sqrt{3}$. It can brief operation of auto transformer as.

1) It operated by a two position switch ie manually automatically using a timer to change over from start to run position.

ii) In starting Position supply is connecting to star windings through an auto transformer which reduced applied voltage to 50, 60, and 70 % of normal value depending on tapping used.

iii) Reduced voltage reduces current in motor windings with 50 % tapping used motors current is halved and supply current will be half of the motor current. Thus, Starting current taken from supply will only be 25 % of the Taken by DOL starter.

iv) For an induction motor, Torque T is developed by $V^2$. Thus on 50 % tapping, Torque at starting is only $(0.5V)^2$ of the obtained by DOL starting: Hence 25 % Torque is produced.

v) Starters used in larger industries. It is larger

in size and expensive.

vi) Switching from start to run positions causing transient current, which can be greater in value than those obtained by DOL starting

4) **Rotor impedance starter:-**

This method allows external resistance to be connected to the rotor through sliprings and boushes. Initially the rotor resistance is set to maximum and is than gradually decreased as the motor speed increased, until it becomes zero.

The rotor impedance starting mechanism is usually very bulky and its expensive when compare with other methods. It also has very high maintenance costs. Also, considerable amount of heat is generated through the resistors when current runs

through them. The starting frequency is also limited is 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 and also improves the power factor.
The circuit diagram is show below: in the circuit diagram, the three slip rings shown are connecting to the rotor terminals of the wound rotor motor.
At the time, of starting of motor, the entire external resistance is added in the rotor circuit.
Than, 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 motor develops load torque The external resistance is removed.