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Class (EET) 4th Smester

Subject: Electrical Machine.2

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Q. No # 01:

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 reliablity factor in the sea envisoment. A three phase induction motor can be used for different applications with various speed and load requirements. 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 DC motor when large speed variations are required.

Nevertheless, The 3-phase induction motors are simple, rugged, 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 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" AC machine in which electrical 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.

Disadvantages :-

- It is essentially a constant speed motor and its speed cannot be changed easily.
- Its starting torque is inferior to DC shunt motor.

Construction :-

The 3-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 asynchronous motor as it runs at a speed other than the synchronous speed.

Like any other electrical motor induction motor also have two 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 the 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 problem with electrical motor is the production of heat during its rotation. In order to overcome this problem we need fan for cooling.
- For receiving external connection terminal box is needed.

Q.No # 02:

Write operation Principal of 3-phase induction motor?

"Ans"

In an AC motor, there's a ring of electromagnets arranged around the outside, which are designed to produce a rotating magnetic field. Inside the stator, there's a solid metal rule, a loop of wire, a coil, a squirrel cage made of metal bars and interconnections, or some other freely

rotating metal part that can conduit electricity. Unlike in a DC motor, where you send power to the inner rotor, in a AC motor you send powes to the outer coil that make up the stator.

The coil 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 so, according to the laws of electromagnetism, the magnetic field produce an electric current inside the rotor. If the conductor is simply a solid piece of metal, eddy current swirl around it instead. Either way, the induced current produces 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 converts electrical energy into mechnical 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 motors. Out of all type, 3-phase induction motor are most widely use for industrial application: mainly because they do not require a starting device, 3-phase induction mot

device 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 motor is based on the production of rotating magnetic field.

Q.No # 03:

Discuss different types of starter for three-phase induction motor?

"Ans"

There are many methods in use to start 3-phase induction motors. Some of the common method are:

i) Direct On-line starter (DOL)
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 method. 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 0.72 to 2 times the full load torque. In order to avoid excessive voltage drop in the supply line due to high starting current, 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 KM controlled by start and stop push buttons. On pressing the start push button S_1. The contactor coil KM is energized from line 1. The 3 main contacts are closed. The motor is thus connected to supply.

when the stop push button S_2 is pressed. Since the KM 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, threw switch change the winding arrangements from star to delta configuration. By connecting the starter 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 starter 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 stator applied voltage. The auto transformer starter is more expensive, more complicated in operation and bulker 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 $1/\sqrt{3}$.

It can brief operation of auto transformer as:

- Operated by a two position switch i.e. using a timer to change over from start to run position.
- In starting position supply is connected to stator windings 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_2. Thus on 50% tapping, torque

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

- Stators used in lager industries it is lager 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 though slip rings and brushes, Initially, the rotor resistance is set to maximum and is then gradually decreased as the motor speed increase, Until it becomes zero. The rotor impedance starting mechanism is usually very bulky and expensive when compared with other method. It also has

very high maintenance costs. Also a considerable amount of heat is generated through the resistors when current runs 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

motor develops load torque the external resistance is removed.