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Department: ~ Electrical Technology

Assignment: ~ AC Machines II

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Question No. 1

Write introduction, Advantage disadvantage & Construction of 3ϕ Induction Motor:

Introduction:

The popularity of 3ϕ induction motors on boad ships is because of their simple robust construction, and high relaibility factor in the sea enviioment. A 3 phase induction motor can use for different applications with various speed and load requirements Electric motors can be found is almost in every production process today.

Advantage:

i-) It has simple and rugged construction

ii-) It is relatively cheap

iii-) It requires little maintanes

iv-) It has high frequency and reasonably good power factor

v-) It has self. starting torque

Disadvantage.

i-) It is essentially a constant speed motor and its speed cant be changed easily

ii-) Its starting torque is inferior to d.c shunt motor

Construction:

The three phase induction motor is the most widely used electrical motor

Parts of induction motor.

(1) Stator

As its name indicates stator is a stationary part of induction motor

A stator winding placed in the stator of induction motor and their a three phase supply is given to it.

Speed is inversally proportional to the No of Poles

$$N_s = \frac{120f}{P}$$

Where N_s = synchronous speed

f = Frequency

P = no. of poles

The stator of 3ϕ induction motor Consist of three main parts

1→ **Stator Fram.**

It is the outer most part of induction motor Its main fuction is to suport the stator core and field widing.

ii) **Stator core:**

The main function of the stator core is to carry the alternating flux. In order to reduce the eddy current loss the stator core is laminated.

iii) **Stator Winding:**

The slots on the periphery of stator core of the motor carries three phase windings. This three phase winding is supplied by the three phase ac supply.

(2) **Rotor**

The rotor is the rotating part of induction motor. The rotor is connected to the mechenical load through the shaft

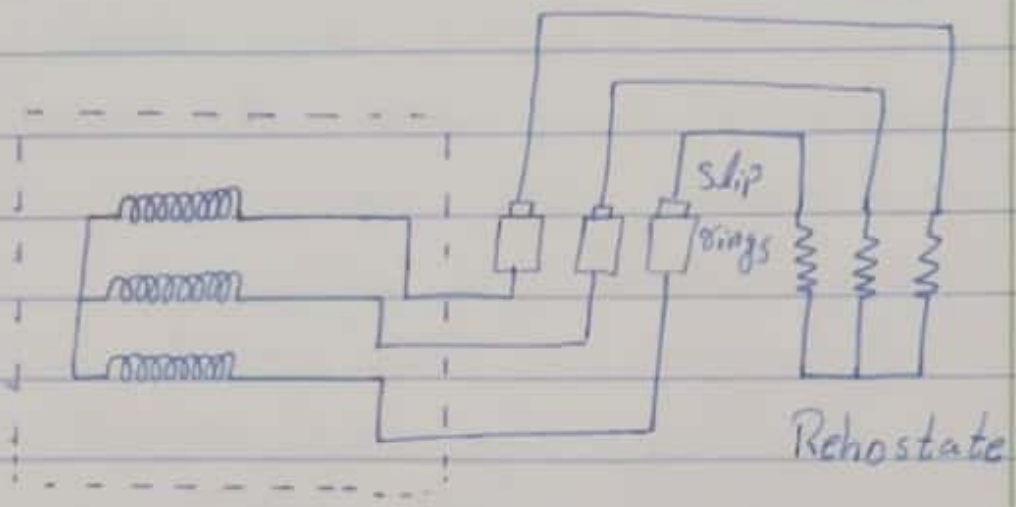
Following two types of rotor

i-) **Squirrel cage rotor**

Squirrel cage three phase induction motor: The rotor of squirrel cage three phase induction motor is cylendrical in shap and have slots on its perifery. The slotes are not made paralled but a bit skewed.

ii-) **Wound rotor:**

Slip ring or Wound rotor three phase induction motor: In this type of three phase induction motor is wound for the same number of pole as that stator but it has less no of slots and has less turns per phase of a heavier conductor. The rotor also carries star delt windings similar that to stator winding.



Rotor Winding

Slip ring rotor

Question No: 2

Write operation principle of three phase induction Motor.

Three Phase rotating Fields.

The three phase induction motor also operates on the principle of rotating megnatic field. The fallowing disscusin shows that how the stator

Windings Connected to a three phase ac input and have a resultant megnatic field that Rotates

Generation of rotating megnatic field.

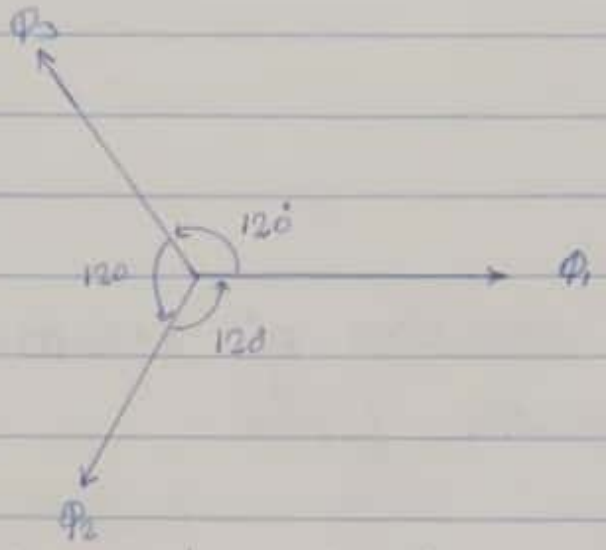
When a 3-phase winding is energized from a three phase supply, a rotating megnatic field is produced this field such that its poles do no remain in a fixed position on the stator but go on shifting their positions around the stator for this reason it is called a rotating Held

Then the mathametical equation for the intantanous Value of the fluxes Φ_1, Φ_2, Φ_3 can be given as:

$\Phi_1 = \Phi m \sin(\omega t) = \phi m \sin\Phi$

$\Phi_2 = \Phi m \sin(\omega t - 120^\circ) = \phi m (\Phi - 120^\circ)$

$\Phi_3 = \Phi m \sin(\omega t - 240^\circ) \quad \phi m (\Phi - 240^\circ)$



Assumed positive direction

Speed of RFM

The speed at which the rotating magnetic field revolves is called syncronous speed (N_s)

Cycles of current = 2/p x revolution of field

$$f = \frac{P}{2} \times \frac{N_s}{60} = \frac{PN_s}{120}$$

$$N_s = \frac{120f}{P}$$

Slip:

It is usually expressed as a percentage of syncronous speed

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$$\% \text{ Slip } S = \frac{N_s - N}{N_s} \times 100$$

(i) The quantity $N_s - N$ is sometimes called slip speed

(ii) When the rotor is stationary (i.e. $N=0$) Slip, $S=1$ or 100%

Rotor Frequency at operation Condition:

The frequency of a Voltage or current induced due to relative speed between winding and a magnetic field is given by general formula

$$f = \frac{PN}{120}$$

Where N = Relative speed between magnetic field and winding

P = No. of poles

$$f_2 = \frac{(N_s - N)P}{120}$$

$$f_2 = \frac{SN_sP}{120}$$

$$f_2 = Sf_1$$

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Question No.3

Discuss different types of stator for three phase induction motor.

i-1 Direct online starter (DOL)

The direct online (DOL) starter is simplest and the most inexpensive of all starting methods and is usually used for squirrel cage induction motor. It directly connects to the contects of the motor to the full supply voltage. The starting current very large normaly 6 to 8 times the rated current. The starting torque is likely 0.75 to 2 times of full load torque. In order to avoide excessive voltage drops in the supply line due to high starting cussents. DOL used of less than 5 kW

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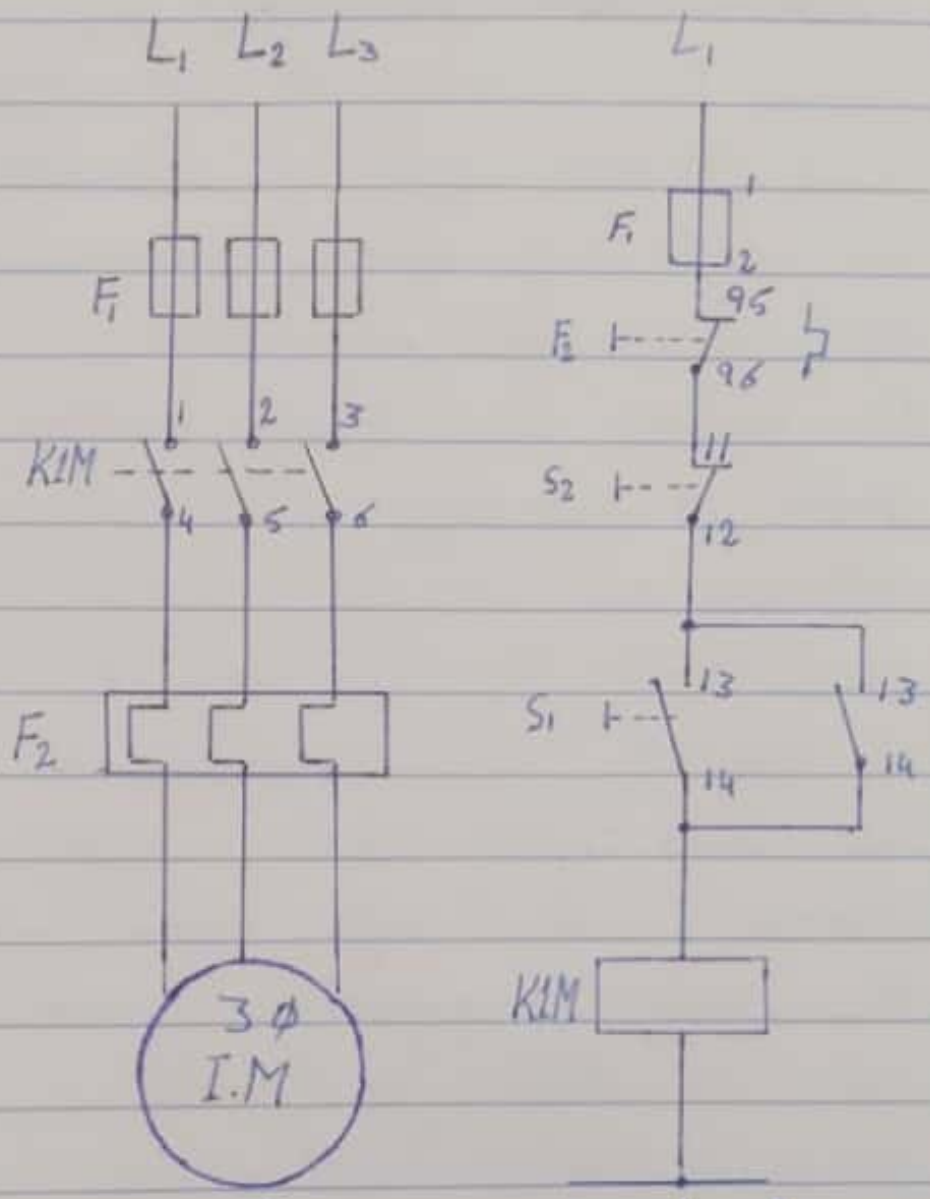
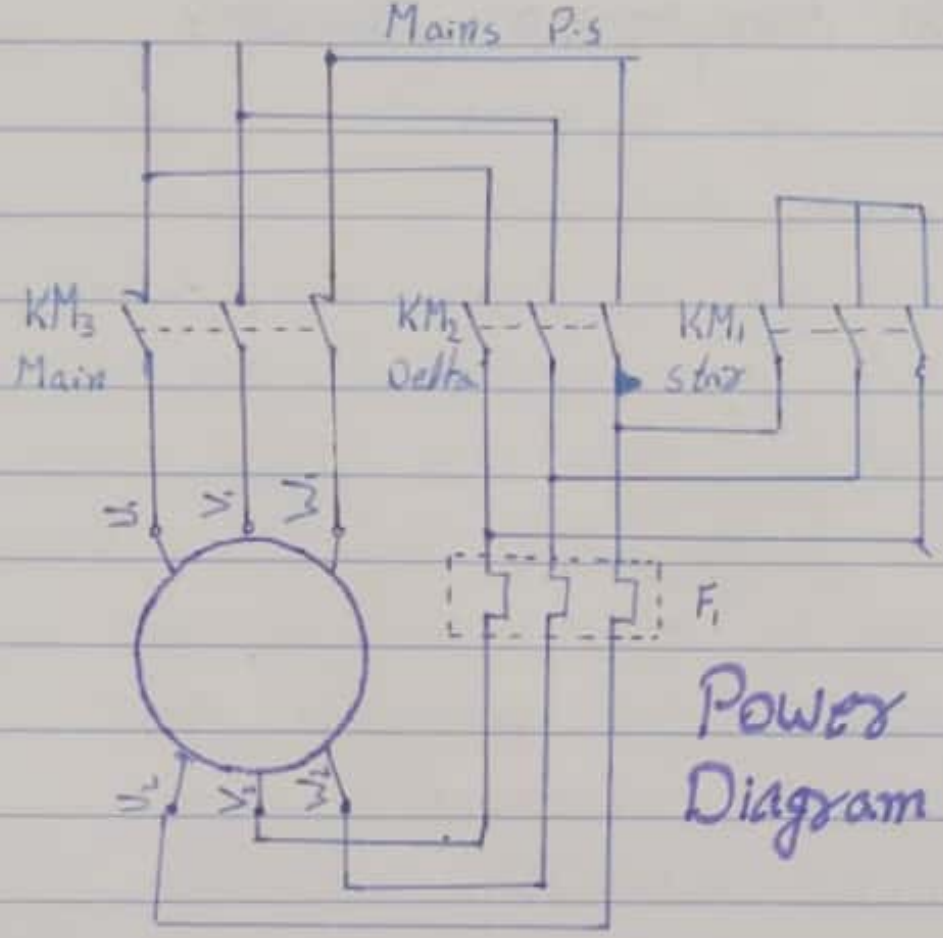


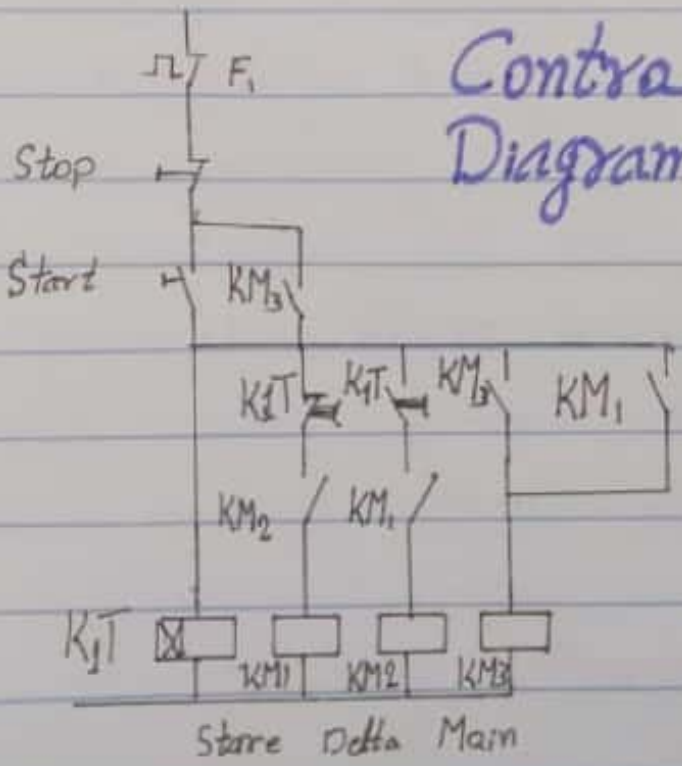
Power circuit ——— Control circuit

Star-Delta starter.

The star delta starting is a common type of starter and extensively used compared to the other types of starters. This method used supply voltage reduce in starting. The method achieved low starting current by first connecting the stator winding in star configration and then after motor achieve certain speed through switch change the winding arrangements from star to delta configration. By connecting the stator windings first in star and then 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



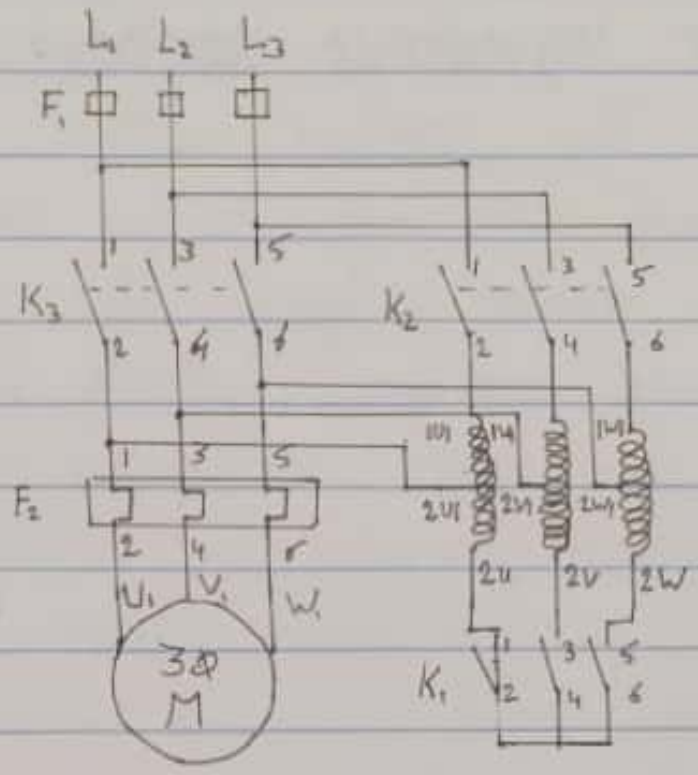
Power Diagram



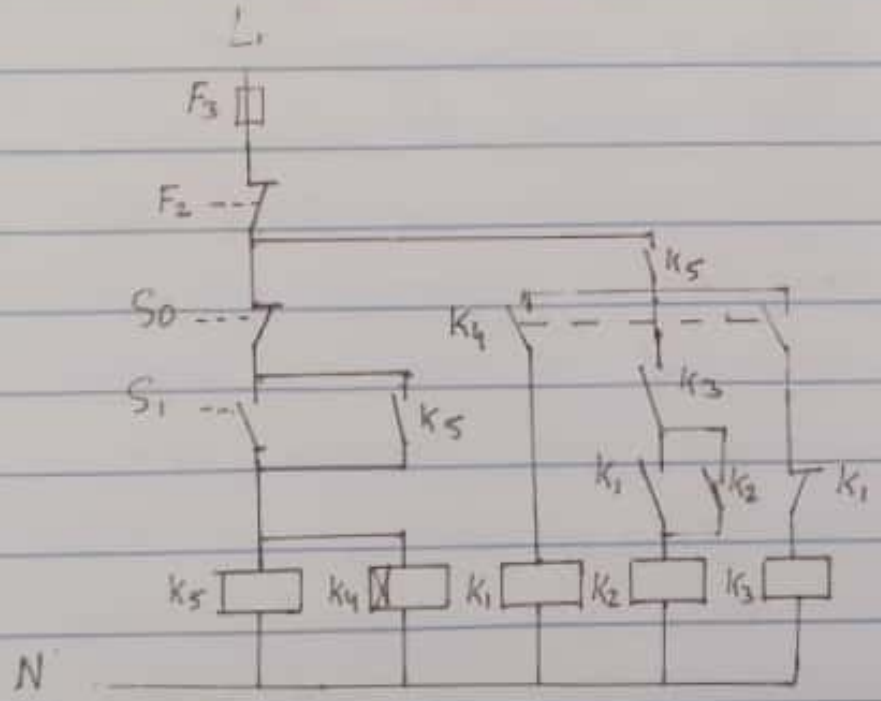
Control Diagram

Auto Transformer starter:

The operation principle of auto transformer starter is similar to star delta starter method. The starting current limited by reduce 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 starter is suitable for both star and delta connected motors, and the starting current and toque can be adjusted to a desired value by taking the correct tapping from the auto transformer



Main Circuit



Auxiliary Circuit

Rotor Impedence starter:

This method allows external resistance to be connected to the rotor through the slip rings and brushes. Initially the rotor the rotor resistance set to maximum and then gradually decrease as the motor speed increases until it become zero. The rotor impedence starting mechinism is usually very bulky and expensive when compared with other method. It also has very large maintaince cost. Also a considerable amount of heat is generated to the resistance when current runs through them. The starting frequency is also limited in this method. However the rotor impedence method allows the motor to be started while on load.

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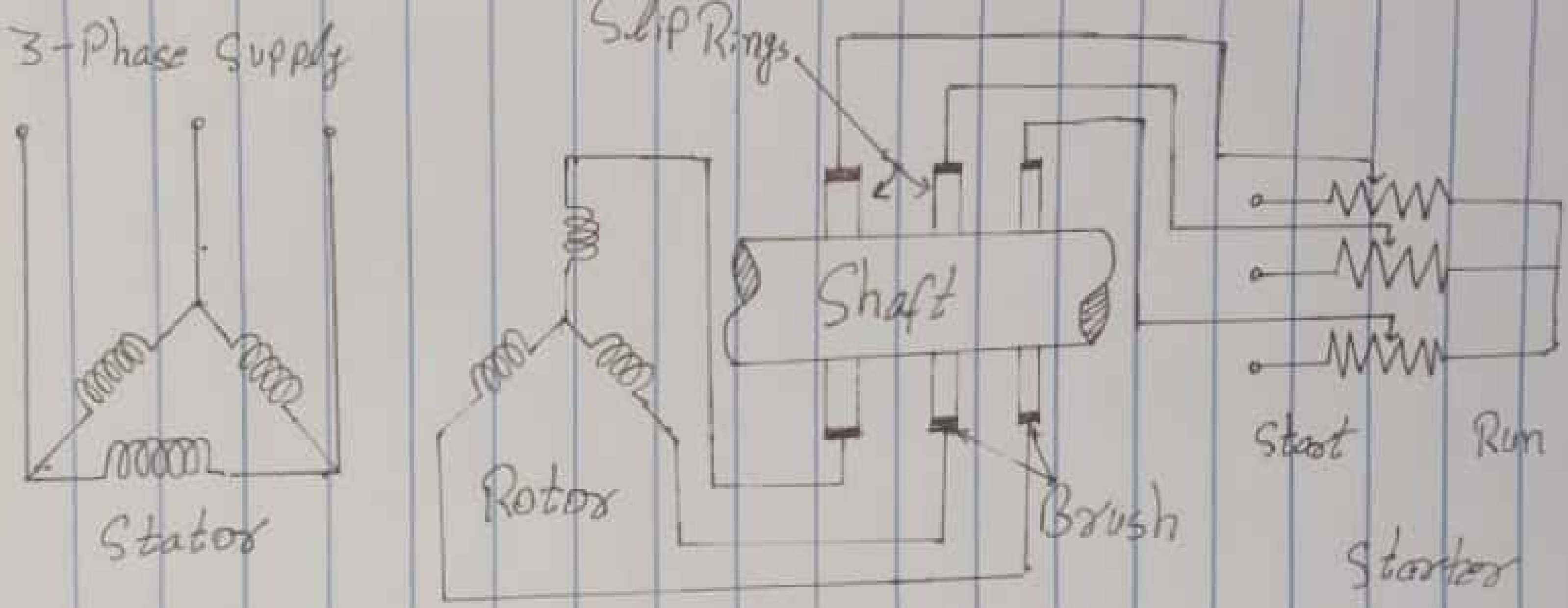

Rotor Impedence starter