SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

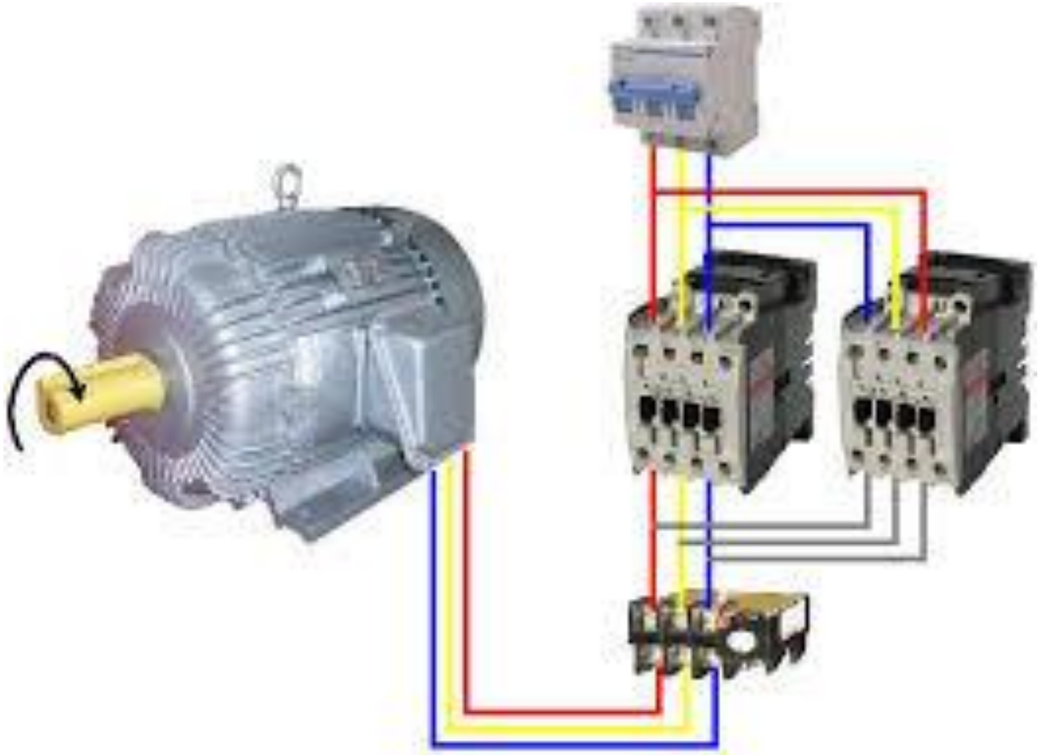
COURSE NAME: 19EET207/ SYNCHRONOUS AND INDUCTION MACHINES

II YEAR / IV SEMESTER

Unit 4 – CONCEPT OF STARTING, BRAKING AND SINGLE PHASE INDUCTION MOTOR

Topic 4: Braking Plugging, dynamic braking and regenerative braking

GUESS THE TOPIC NAME…



Induction Motor Braking

- Induction motors are used at various places. Speed control of induction motors is quite difficult and that's why their use was restricted and DC motors had to be used as their speed regulation was possible.

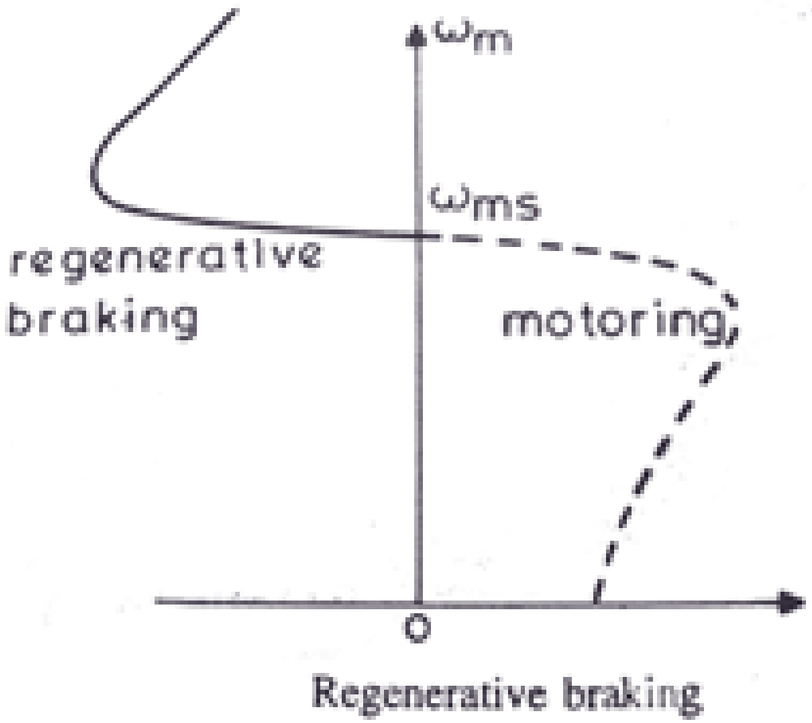
- But when induction motor drives were invented and implemented, they were given preference because of many advantages over DC motors.

- Whenever controlling of motors is done, braking is the most important term, so as with induction motors. Induction motor braking can be done by different methods, which are-
    1. Regenerative braking of induction motor
    2. Plugging Braking of induction motor
    3. Dynamic braking of induction motor is further categorized as
        - AC dynamic breaking
        - Self excited braking using capacitors
        - DC dynamic braking
        - Zero Sequence braking

Regenerative Braking of Induction Motor

We know the power (input) of an induction motor is given as.

$P_{in} = 3VI_s\cos\phi_s$



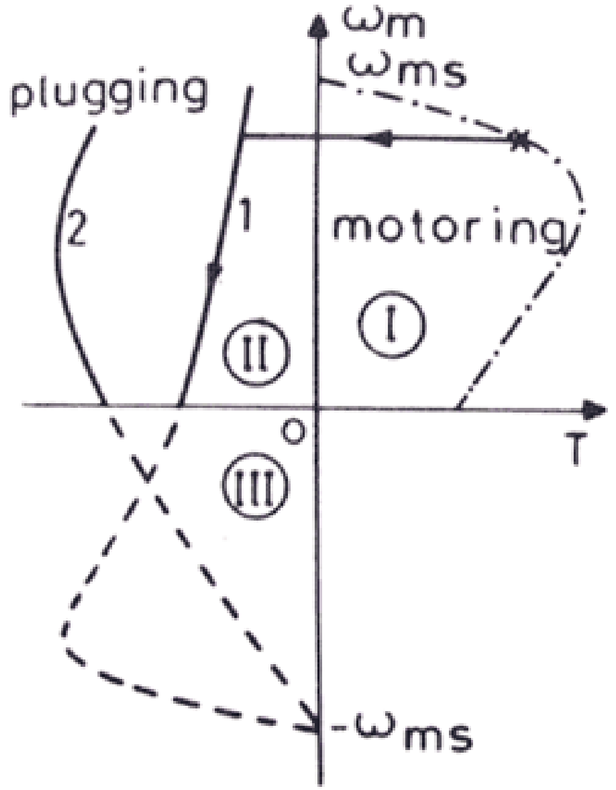
Regenerative braking

- Here, ϕs the phase angle between stator phase voltage V and the stator phase current Is.
- Now, for motoring operation ϕs < 90o and for braking operation ϕs > 90o.
- When the speed of the motor is more than the synchronous speed, relative speed between the motor conductors and air gap rotating field reverses, as a result the phase angle because greater than 90o and the power flow reverse and thus regenerative braking takes place.
- The main advantage of this kind of braking can be said that the generated power is use fully employed and the main disadvantage of this type of braking is that for fixed frequency sources, braking cannot happen below synchronous speeds

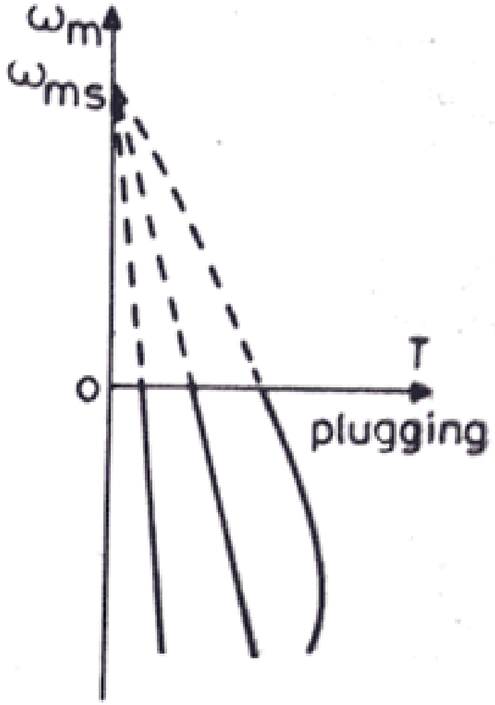
Plugging Braking of Induction Motor

- Plugging induction motor braking is done by reversing the phase sequence of the motor.
- Plugging braking of induction motor is done by interchanging connections of any two phases of stator with respect of supply terminals.
- And with that the operation of motoring shifts to plugging braking. During plugging the slip is (2 – s), if the original slip of the running motor is s, then it can be shown in the following way

Plugging Braking of Induction Motor



(a) 1: natural characteristic
2: with external resistance in rotor



(b) Plugging in IV quadrant with large external resistance in rotor

- From the figure beside we can see that the torque is not zero at zero speed.
- That's why when the motor is needed to be stopped, it should be disconnected from the supply at near zero speed.
- The motor is connected to rotate in the reverse direction and the torque is not zero at zero or any other speed, and as a result the motor first decelerates to zero and then smoothly accelerates in the opposite direction

Dynamic Braking of Induction Motor

AC Dynamic Braking

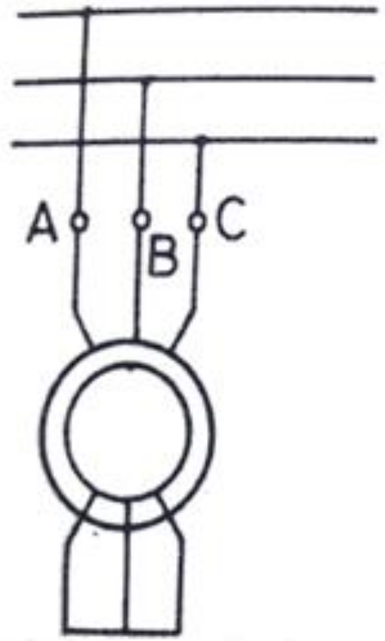
- This type of induction motor braking is obtained when the motor is made to run on a single phase supply by disconnecting any one of the three phase from the source, and it is either left open or it is connected with another phase.

- When the disconnected phase is left open, it is called two lead connection and when the disconnected phase is connected to another machine phase it is known as three load connection.

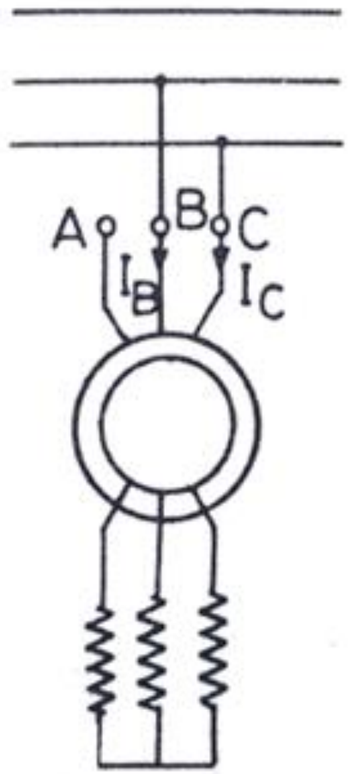
- The braking operation can be understood easily. When the motor is running on 1-phase supply, the motor is fed by positive and negative sequence, net torque produced by the machine at that point of time is sum of torques due to positive and negative sequence voltage.

- At high resistance the net torque is found to be negative and braking occurs. From the figure below the two and three load connections can be understood.

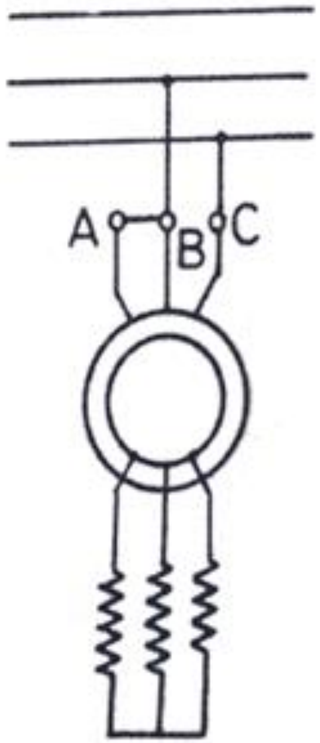
AC Dynamic Braking



(a) Motoring



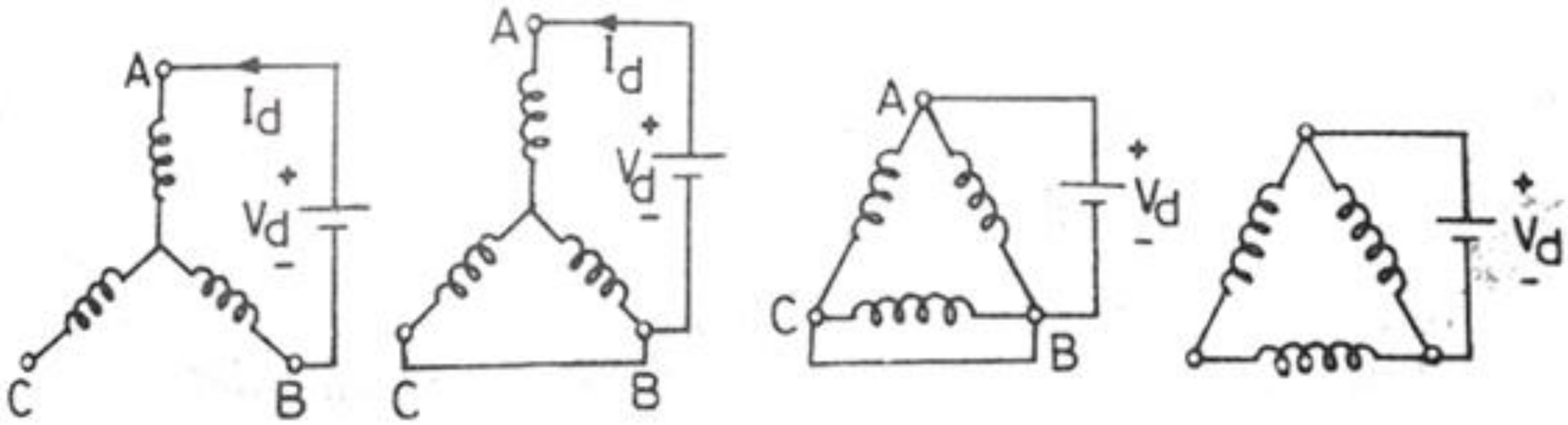
(b) Two lead connection



(c) Three lead connection

DC Dynamic Braking

To obtain this type of braking the stator of a running induction motor is connected to a DC supply. Two and three load connections are the two common type of connections for star and delta connected stators.



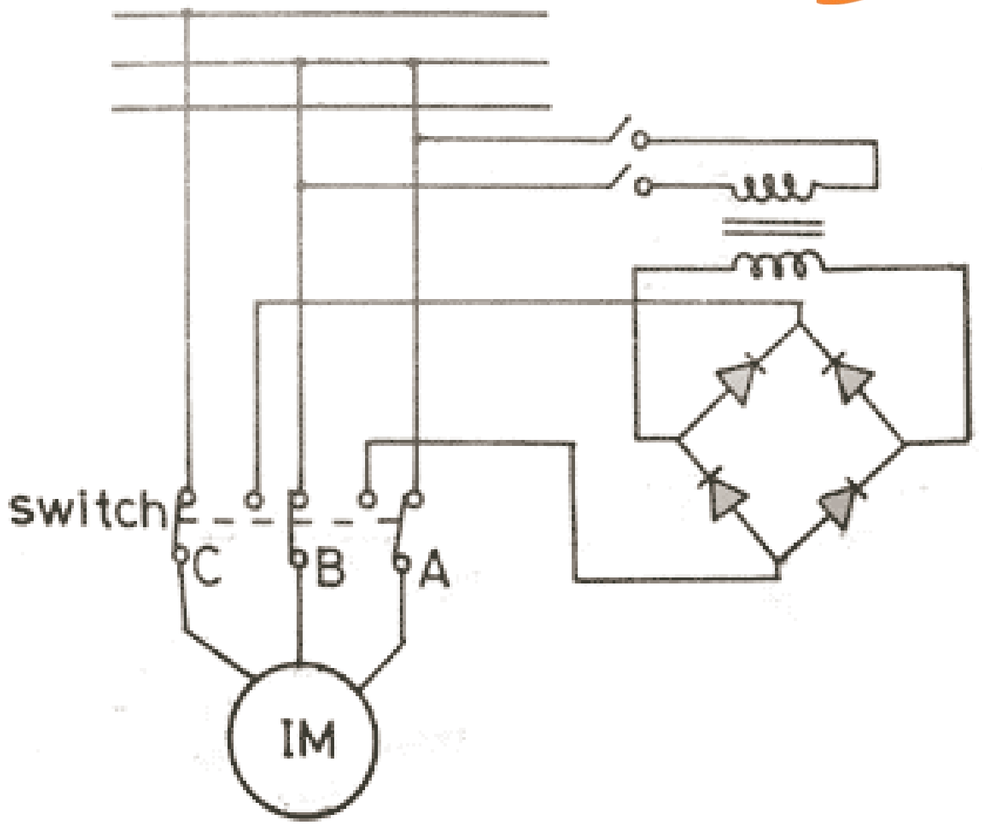
(a) (b) (c) (d)

Various stator connections for dc dynamic braking (a) and (d) are two lead connections and (b) and (c) are three lead connection

DC Dynamic Braking

Two Loads DC Dynamic Braking Operation

Now coming to the method of operation, the moment when AC supply is disconnected and DC supply is introduced across the terminals of the induction motor, there is a stationery magnetic field generated due to the DC current flow and as the rotor of the motor rotates in that field, there is a field induces in the rotor winding, and as a result the machine works as a generator and the generated energy dissipates in the rotor circuit resistance and dynamic braking of induction motor occurs.



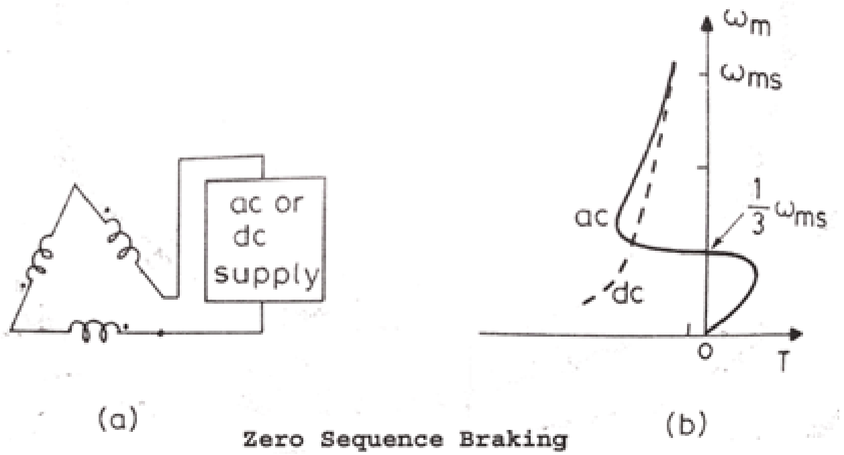
Zero Sequence Braking

In this type of braking all the three stator phases are connected in series and single phase AC or DC is connected across them

This type of connection is called zero-sequence connection, because current in all the stator windings are co-phasal.

When the connected supply is AC, resultant field is stationery in space and pulsates at the frequency of supply, when the supply is DC, resultant field is stationery and is of constant magnitude.

The main advantage of this induction motor braking is that all the stator phases are uniformly loaded. It does not require large rotor resistance like AC dynamic braking, it does not require large rotor resistance. The circuit diagram and the speed torque characteristics are shown below.



Zero Sequence Braking

SUMMARY

Braking Plugging, dynamic braking and regenerative braking

KEEP
LEARNING..

Thank u

SEE YOU IN NEXT CLASS