Three phase system

Three phase system :

This type of network is very generally used in industrial purpose . However , most three phase systems are approximately balanced , and if a system considered to be balanced the resulting simplicity of analysis is very marked.

Interconnection of three phase:

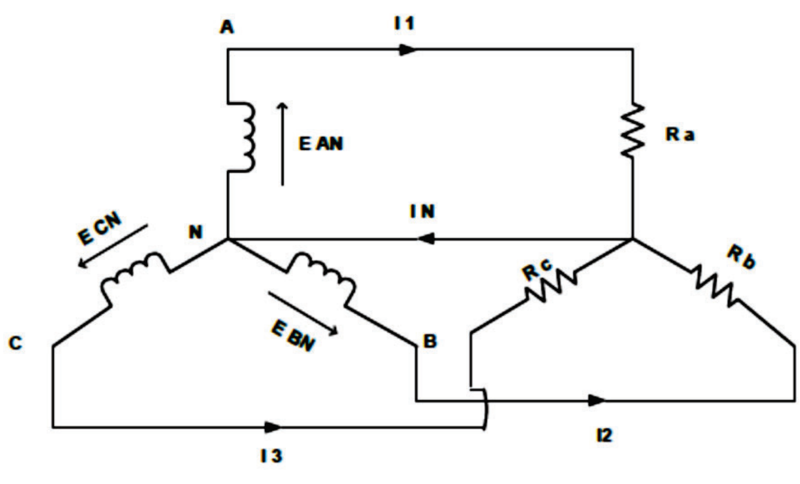
There are two types of connection:

1. **Star or Wye connection.**
2. **Mesh or delta connection .**

1. Star connection:

In this type of connection ends of three coils joined together at point N . The point N is known as star point or neutral point .This type is known as four wire three phase system .

Star connection: This type of connection shown in figure below .



EAB = EBC = ECA = Line voltage (VL)

EAN = EBN = ECN = Phase voltage (Vph)

Line current = Phase current , IL = Iph

$V_L = \sqrt{3}\, V_{ph}$

$E_{AN} = E \ \underline{/0}$

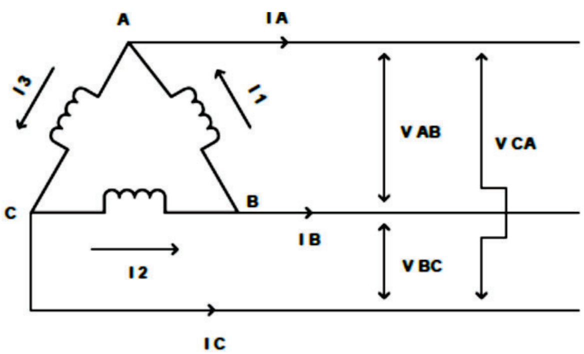
$E_{BN} = E \ \underline{/-120}$

$E_{CN} = E \ \underline{/120}$

IN = I1 + I2 + I3

In case of balance load , the neutral current (IN) is equal to zero .

Delta connection : This type of connection shown in the figure below .



VAB = VBC = VCA = line voltage = phase voltage

IL=3Iph

IA = I1 – I3

IB = I2 – I1

IC = I3 – I2

VAB = V / 0

VBC = V / - 120

VCA = V / 120

Lecturer: Omar A. Alkawak
E-mail: OmarAhmed@mustaqbal-college.edu.iq

Three phase induction motor

Three phase induction motor:

Three phase induction motor is extensively used for various kinds of industrial drives . It has the following main advantages and also some disadvantages.

Advantages :

1. Its cost is low and it is very reliable.
2. It has sufficiently high efficiency . In normal running conditions, no brushes areneeded , hence frictional losses are reduced . It has a reasonably good power factor .
3. It requires minimum of maintenance.
4. Its starting arrangement is simple .

Disadvantages

1. Its speed cannot be varied without sacrificing some of its efficiency
2. Its speed decrease with increase in load .

Construction:

An induction motor consists essentially of two main parts :

1. **Stator**
2. **Rotor**

a) Stator:

The stator of induction motor is , in principle , made up of a number of stampings which are slotted to receive the windings . The stator carries a 3 – phase winding and is fed from a 3 – phase supply . It is wound for a definite number of poles , the exact number of poles being determined by the requirements of speed . Greater the number of poles , lesser the speed and vice versa.

When the stator windings supplied with 3 – phase currents produce a magnetic flux which is of constant value but which rotate at synchronous speed (given by $N_s=120f/p$). This revolving magnetic flux induced an e.m.f. in the rotor by mutual induction

b) Rotor:

Almost 90 percent of induction motor are squirrel – cage type , because this type of rotor has the simplest and most rugged construction and is almost indestructible . This rotor consists of a cylindrical laminated core with parallel slots for carrying the rotor conductors which, are not wires but consist of bars of copper , aluminum or alloys . One bar is placed in each slot .The rotor bars are permanently short– circuited on themselves hence it is not possible to added any external resistance in series with the rotor circuit for starting purposes.

Running operation :

If the stator windings are connected to a three – phase supply and the rotor circuit is closed the induced voltage in the rotor windings produce rotor currents that interact with the air gap field to produce torque . The rotor , if free to do so , will then start rotating .

According to Lenzs law , the rotor rotates in the direction of the rotating field such that the relative speed between the rotating field and the rotor windings decreases . The rotor will eventually reach a steady – state speed (N) that is less than the synchronous speed (NS) at which the stator rotating field rotates in the air gap . It is obvious that at N = NS there will be no induced voltage and current in the rotor circuit and hence no torque.

The difference between the rotor speed (N) and the synchronous speed (NS) of the rotating field is called the slip (S) and is defined as

$$S = \frac{N_S - N}{N_S}$$

The rotor was slipping behind the rotating field by slip r.p.m = NS – N = SNS

The frequency f2 of the induced voltage and current in the rotor circuit will corresponding to the slip r.p.m , because this is the relative speed between the rotating field and the rotor winding .

The rotor was slipping behind the rotating field by slip r.p.m = NS – N = SNS

The frequency f2 of the induced voltage and current in the rotor circuit will corresponding to the slip r.p.m , because this is the relative speed between the rotating field and the rotor winding .

The revolutions per minute (N) of the traveling wave in a p – pole motor for frequency f) cycles per second is

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

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

$$f_2 = \frac{P}{120}\, S\, N_s$$

$$f_2 = S\, f_1$$

Where:

f1 is the frequency of supply voltage .

f2 is the frequency of rotor circuit .

p is the number of poles.

S is the slip .