THREE PHASE TRANSFORMERS

THREE PHASE SYSTEM

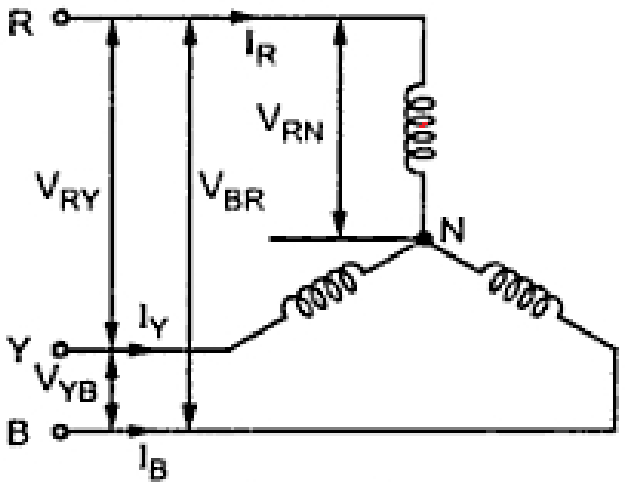
BASICS

Line voltage V_L= voltage between lines

Phase voltage Vph= voltage between a line and neutral

THREE PHASE SYSTEM

BALANCED STAR



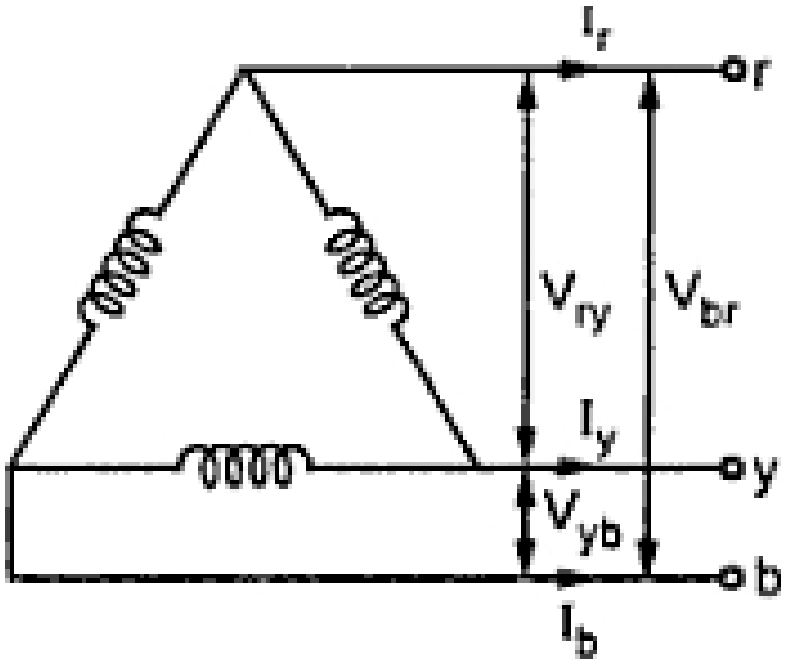
Line Voltage,

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

Line current, $I_L = I_{ph}$

THREE PHASE SYSTEM

BALANCED DELTA



Line Voltage $V_L = V_{ph}$

Line current $I_L = \sqrt{3}\ I_{ph}$

THREE PHASE TRANSFORMERS

Almost all major generation & Distribution Systems in the world are three phase ac systems
Three phase transformers play an important role in these systems

3 phase transformers can be constructed from

(a) 3 single phase transformers

(b) 2 single phase transformers

(c) using a common core for three phase windings

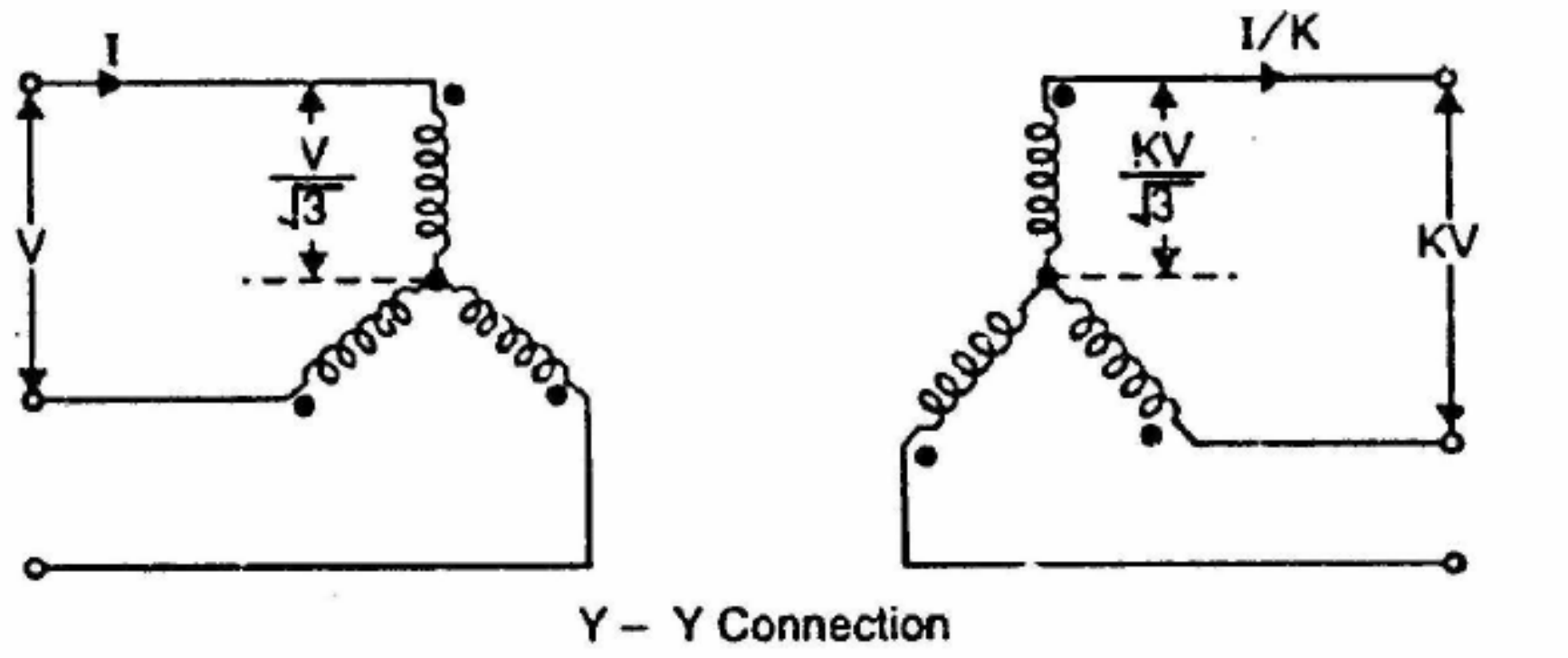
3 phase Transformer connections

By connecting three single phase transformers

1. **Star- Star connection**
2. **Delta- Delta connection**
3. **Star – Delta connection**
4. **Delta – Star connection**

$$\text{Phase transformation ratio, } K = \frac{\text{Secondary phase voltage}}{\text{Primary phase voltage}} = \frac{N_2}{N_1}$$

Star- Star connection



Y – Y Connection

- **This connection satisfactory only in balanced load otherwise neutral point will be shifted.**

Star- Star connection

Advantages

1.Requires less turns per winding i.e. cheaper

Phase voltage is 1/√3 times of line voltage

2.Cross section of winding is large i.e. stronger to bear stress during short circuit

Line current is equal to phase current

3. Less dielectric strength in insulating materials

phase voltage is less

Star- Star connection

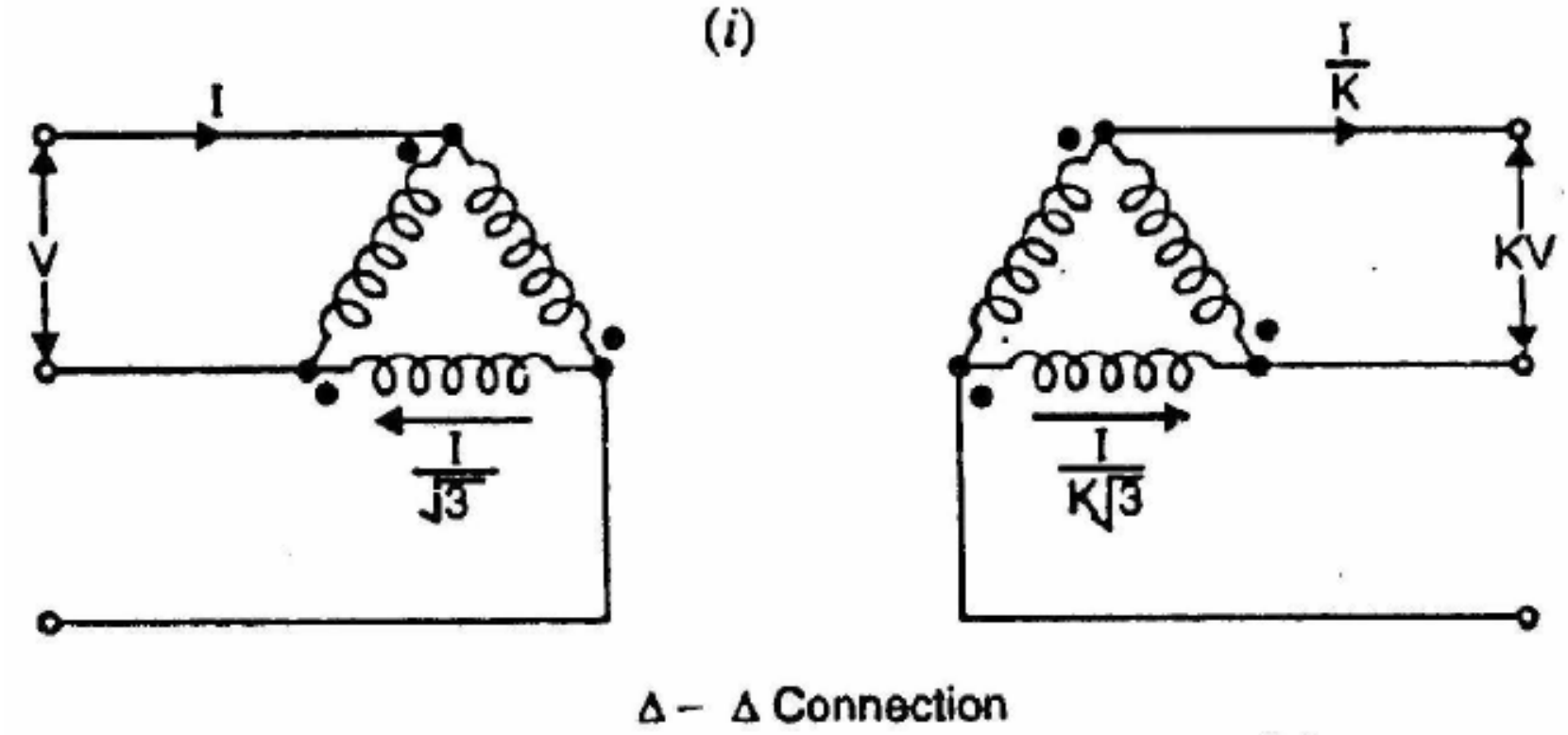
Disadvantages

1. If the load on the secondary side unbalanced then the shifting of neutral point is possible

2. The third harmonic present in the alternator voltage may appear on the secondary side. This causes distortion in the secondary phase voltages

3. Magnetizing current of transformer has 3^{rd} harmonic component

Delta - Delta connection



Δ – Δ Connection

- **This connection is used for moderate voltages**

Delta - Delta connection

Advantages

1. System voltages are more stable in relation to unbalanced load
2. If one t/f is failed it may be used for low power level i.e. V-V connection
3. No distortion of flux i.e. 3rd harmonic current not flowing to the line wire

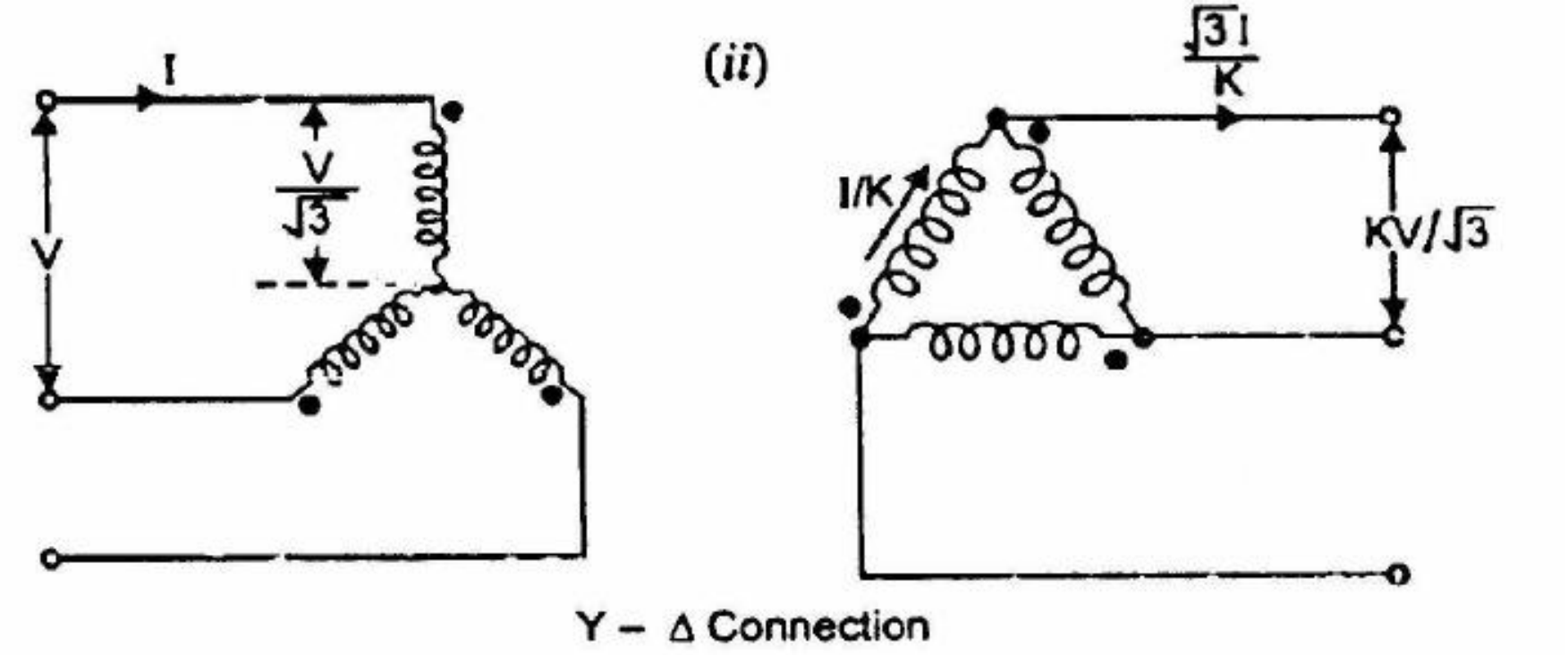
Delta - Delta connection

Disadvantages

1.Compare to Y-Y require more insulation.

2. Absence of star point i.e. fault may severe.

Star- Delta connection



Y – Δ Connection

- **Used to step down voltage i.e. end of transmission line**

Star- Delta connection

Advantages

1. **The primary side is star connected. Hence fewer number of turns are required. This makes the connection economical**

2. **The neutral available on the primary can be earthed to avoid distortion.**

3. **Large unbalanced loads can be handled satisfactory.**

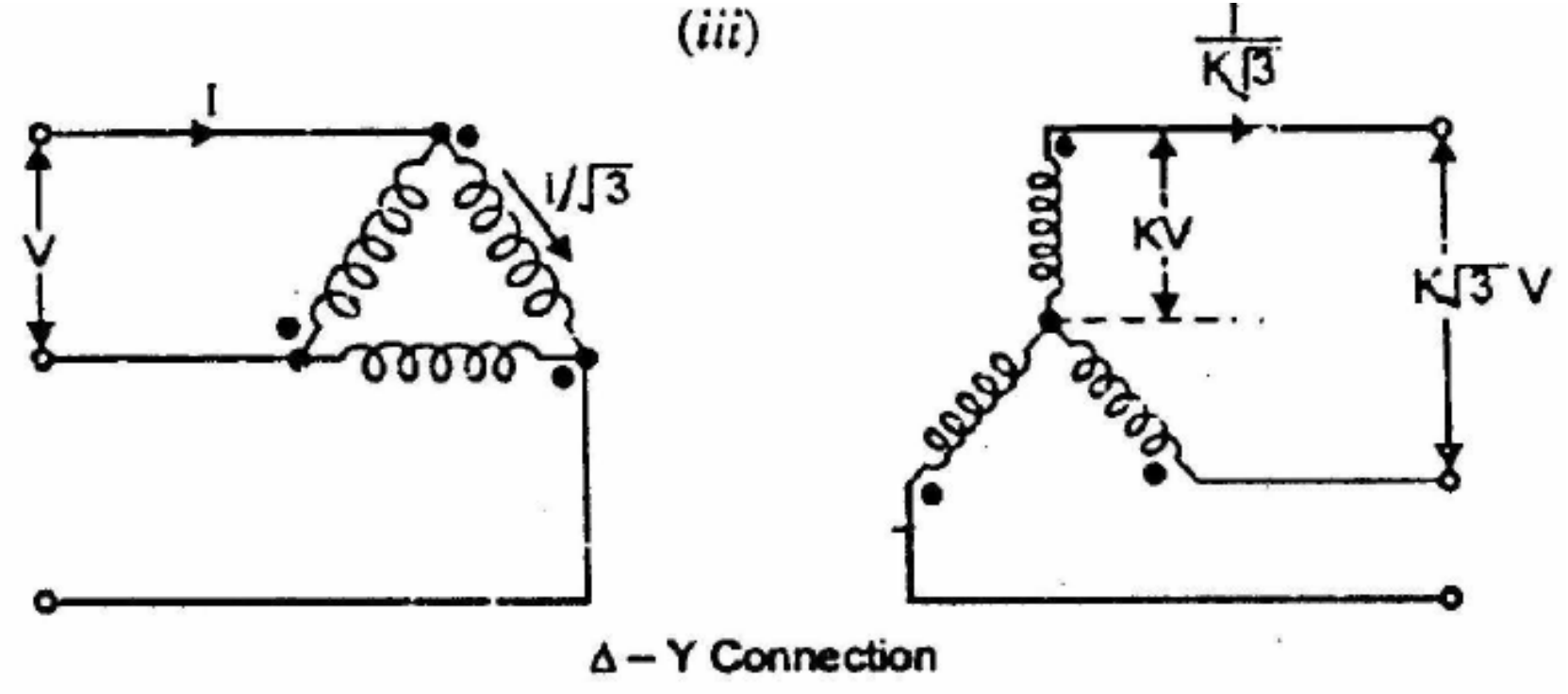
Star- Delta connection

Disadvantages

The secondary voltage is not in phase with the primary. (30 ^{0} phase difference)

Hence it is not possible to operate this connection in parallel with star-star or delta-delta connected transformer.

Delta - Star connection



- **This connection is used to step up voltage ie. Beginning of high tension line**

Delta - Star connection

Features

- **secondary Phase voltage is $1/\sqrt{3}$ times of line voltage.**
- **neutral in secondary can be grounded for 3 phase 4 wire system.**
- **Neutral shifting and 3^{rd} harmonics are there.**
- **Phase shift of 30^{0} between secondary and primary currents and voltages.**

THANK YOU