NOTES Class 50

Advantages of Three Phase Systems over Single Phase Systems

1. For certain amount of power to be transmitted over certain distance, a three phase system requires less conductor material compared to single phase system.

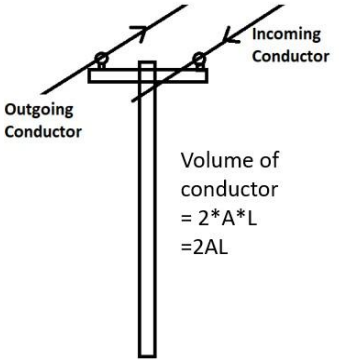


Fig: Single Phase Transmission Line

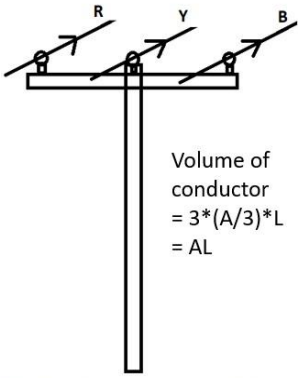


Fig: Three Phase Transmission Line

2. For the same frame size, a three phase machine can handle higher amount of power compared to its single phase counterpart.
3. Single Phase Power is pulsating in nature, whereas three phase power flowing into a three phase motor is almost constant at every instant. Hence, three phase motors run smoother and less noisy & hence, have better lifespan than a single phase motor.
4. Three Phase Induction Motors are self-starting whereas single phase induction motors are not self-starting in nature which makes three phase induction motors widely popular in

industrial drives.

Numerical Example on Wattmeter

Method Question:

A 3-phase Y-connected, balanced load with a lagging power factor is supplied at 400 V (between the lines). A wattmeter when connected with its current coil in the R-line and voltage coil between R and Y lines gives a reading of 6kW. When the same terminals of the voltage coil are switched over to Y- and B-lines, the current coil connections remaining the same, the reading of the wattmeter remains unchanged. Calculate the line current and power factor of the load. Phase sequence is RYB.

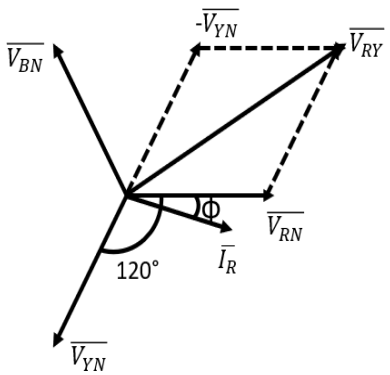
Solution:

Case 1: CC in R-line and PC between R & Y

lines Wattmeter reading,

W1 = VRY*IR*cos(∟(VRY ,IR))

$$\bar{V}_{R\bar{Y}} = \bar{V}_{R\bar{N}} - \bar{V}_{Y\bar{N}}$$

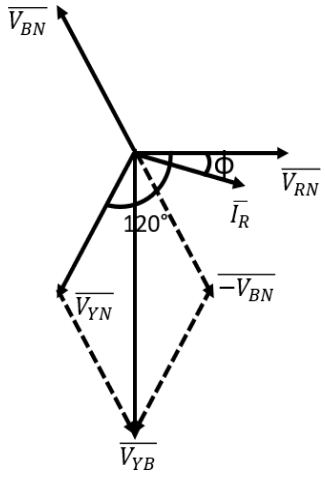


Therefore, W1 = VL*IL*cos(30+ϕ) = 6000W

(given) **Case 2: CC in R-line and PC between Y & B lines Wattmeter reading,**

W2 = VYB*IR*cos(∟(VYB ,IR))

$\bar{V}_{Y\bar{B}} = \bar{V}_{Y\bar{N}} - \bar{V}_{B\bar{N}}$



Therefore, W2 = VL*IL*cos(90-ϕ) = 6000W (given)

Since it is given that wattmeter reading is same in both the cases,

W1 = W2

i.e., VL*IL*cos(30+ϕ) = VL*IL*cos(90-ϕ)

Therefore, cos(30+ϕ) = sinϕ

Hence, ϕ = 30°

Therefore, Power factor = cosϕ = 0.866 Lag

To find Line current IL , substitute VL & ϕ values either in W1 equation or W2 equation above.

Therefore, W1 = VL*IL*cos(30+ϕ) =

6000W Hence, Line current, IL = 30A