ELEMENTS OF ELECTRICAL ENGINEERING
Course Code : UE25EE141A/B

PES UNIVERSITY

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ELEMENTS OF ELECTRICAL ENGINEERING

Advantages of Three Phase Systems over Single Phase Systems , Numerical Examples

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Advantages of Three 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.

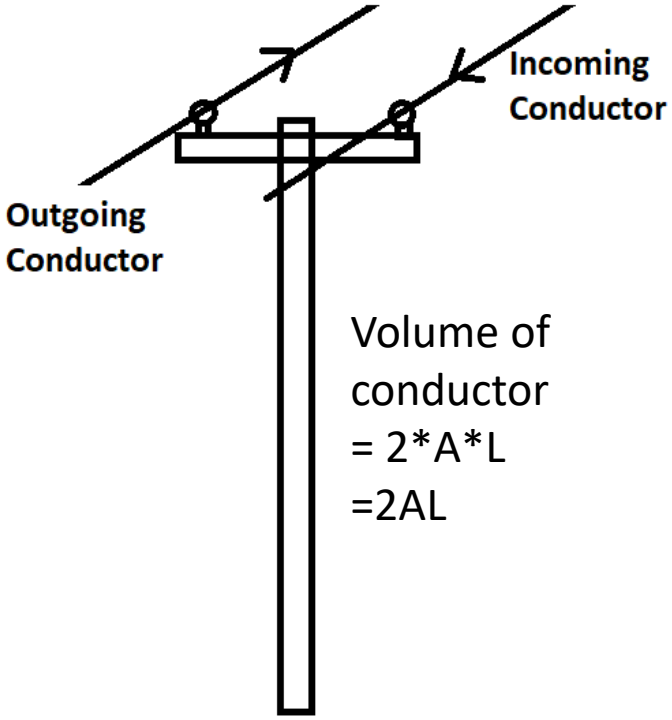

Fig: Single Phase Transmission Line

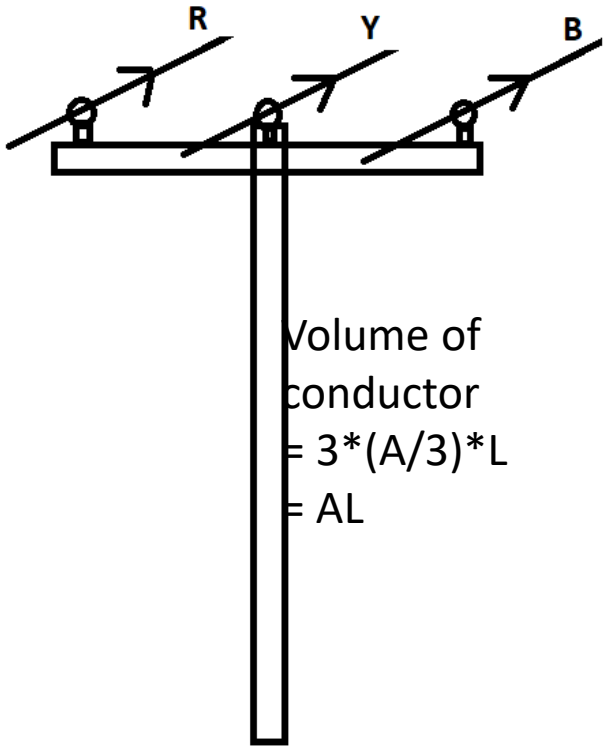

Fig: Three Phase Transmission Line

Advantages of Three Phase Systems (contd..)

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, where as 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 where as 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.

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Numerical Example on Wattmeter Method

$\overline{V_{RN}}$

Solution:

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

Wattmeter reading,

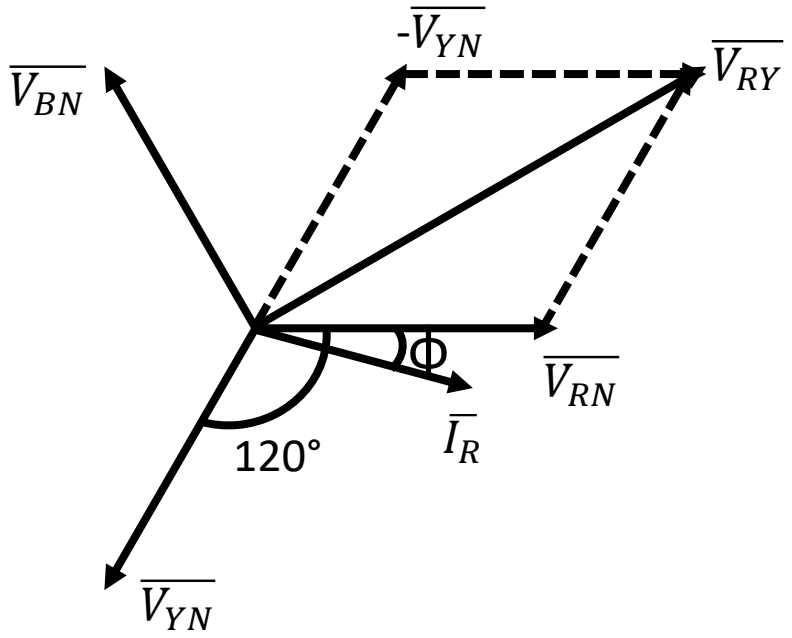
$W_1 = V_{RY} * I_R * \cos(\angle(V_{RY}, I_R))$

$\overline{V_{RY}} = \overline{V_{RN}} - \overline{V_{YN}}$

Therefore,

$W_1 = V_L * I_L * \cos(30+\phi)$

$= 6000W$ (given)



Numerical Example on Wattmeter Method

Case 2: CC in R-line and PC between Y & B lines

Wattmeter reading,

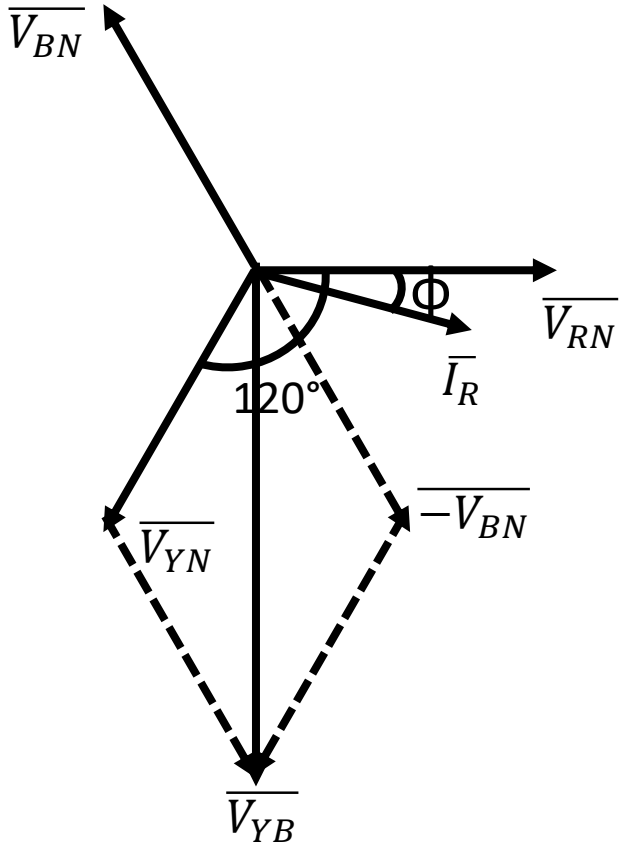
$W_2 = V_{YB} * I_R * \cos(\angle(V_{YB}, I_R))$

Therefore,

$W_2 = V_L * I_L * \cos(90-\phi)$

$= 6000W$ (given)

$$\overline{V_{YB}} = \overline{V_{YN}} - \overline{V_{BN}}$$



Numerical Example on Wattmeter Method

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

$W_1 = W_2$

i.e., $V_L * I_L * \cos(30+\phi) = V_L * I_L * \cos(90-\phi)$

Therefore, $\cos(30+\phi) = \sin\phi$

Hence, $\phi = 30°$

To find Line current I_L , substitute V_L & ϕ values either in W_1 equation or W_2 equation above.

Therefore, $W_1 = V_L * I_L * \cos(30+\phi) = 6000W$

➡ Line current, $I_L = 30A$

Text Book & References

Text Book:

1. "Basic Electrical Engineering" S.K Bhattacharya, 1st Edition Pearson India Education Services Pvt. Ltd., 2017
2. "Basic Electrical Engineering", D. C. Kulshreshta, 2nd Edition, McGraw-Hill. 2019
3. "Special Electrical Machines" E G Janardanan, PHI Learning Pvt. Ltd., 2014

Reference Books:

1. "Engineering Circuit Analysis" William Hayt, Jack Kemmerly, Jamie Phillips and Steven Durbin, 10th Edition McGraw Hill, 2023

2. "Electrical and Electronic Technology" E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 12th Edition, Pearson Education, 2016.

THANK YOU

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