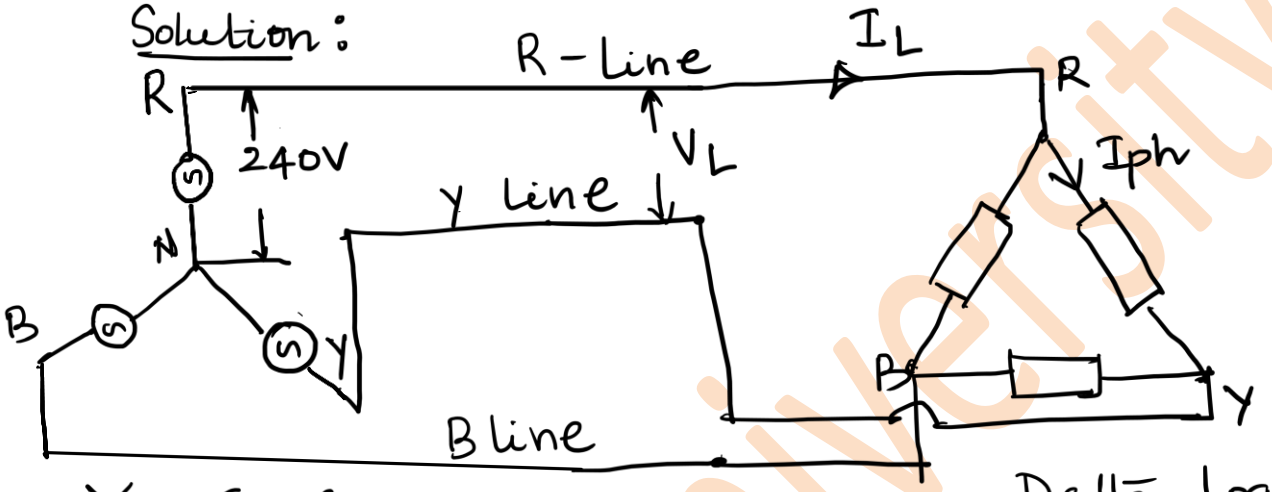
Lecture 45

2. A 3-phase delta connected load, each phase has a impedance of (25+j40) Ω. The load is fed from the secondary of a 3-phase star connected transformer which has phase voltage of 240V. Draw the circuit diagram and calculate i) current in each phase of the load ii) voltage across each phase of the load iii) current in the transformer secondary winding iv) power supplied to the load.

Solution:



Y - Source
[Transformer Secondary winding]

Delta load

$Z = (25 + j40)$

$Z = 47.16 \angle 58^\circ \ \Omega$

Given: Phase voltage Across Source $V_{ph(s)}$ } $= 240V$

Since source is of Y type

$V_L = \sqrt{3}\, V_{ph} = 240 \times \sqrt{3} = 415.69V$

Since Load is Delta Connected

$V_{ph(load)} = V_L = 415.69\ V$

Phase current in the load

$$= \frac{V_{ph(Load)}}{|Z|} = 8.81\ A$$

$$\Rightarrow I_L = \sqrt{3}\, I_{ph(Load)}$$

$$= \sqrt{3} \times 8.81 = 15.26\ A$$

Let us consider 1st phase voltage in the load as ref.

(ii) voltage across each phase of the load

$$415.69 \angle 0^\circ\ V,$$

$$415.69 \angle -120^\circ\ V,$$

$$415.69 \angle -240^\circ\ V,$$

(i) $$I_{ph_1(Load)} = \frac{V_{ph_1(load)}}{Z}$$

$$= \frac{415.69}{47.16 \angle 58^\circ} = 8.81 \angle -58^\circ A$$

Other two phase currents are

$I_{ph_2} = 8.81 \angle -178^\circ$ A

$I_{ph_3} = 8.81 \angle -298^\circ$ A

(iii) Currents in Transformer Secondary winding are same as line currents

$I_{L_1} = 15.26 \angle -58 - 30 = 15.26 \angle -88^\circ$ A

$I_{L_2} = 15.26 \angle -208^\circ$ A

$I_{L_3} = 15.26 \angle -328^\circ$ A

(iv) Power supplied to the load

$P_{3-phase} = 3 I_{ph}^2 R$

$= 3 (8.81)^2 25$

$= 5.82$ KW