NOTES Class-45

Numerical Examples on Balanced Delta connected Three Phase System:

Numerical Example 1:

Question:

A balanced delta connected load consumes 2 KW of power when connected to a three phase, 400 V, 50Hz supply. The same load when connected to a three phase 230V , 50 Hz supply, draws a current of 2 A at lagging power factor. Determine the load power factor and resistance and inductance per phase.

Solution :

Case1: Delta connected Load

Given Data:

Line voltage, V_L = 400V ; f = 50Hz

Three phase Active Power, $P_{3\text{-phase}}$ = 2KW

Therefore, $3*V_{ph}*I_{ph}*\cos\phi = 2000W$

i.e., $3* V_{ph} * \frac{V_{ph}}{Z} * \frac{R}{Z} = 2000W$

Since, delta connected system, $V_{ph} = V_L = 400V$

Therefore, $3* 400^2 * \frac{R}{Z^2} = 2000W$; Hence, $\frac{R}{Z^2} = 0.004167$--------(1)

Case2: Same Delta connected Load

Given Data:

Line voltage, V_L = 230V ; f = 50Hz

Line current, I_L = 2A

Since same load, Z is same in both the cases.

Since, delta connected system, $V_{ph} = V_L = 230V$

And, $I_{ph} = \frac{I_L}{\sqrt{3}} = 1.155A$

Therefore, $Z = \frac{V_{ph}}{I_{ph}} = 199.13\Omega$

Substituting 'Z' value in equation (1) above,

Resistance per phase, R = 165.24Ω

Inductive reactance per phase, $X_L = \sqrt{Z^2 - R^2} = 111.12\Omega$

Inductance per phase, $L = \frac{X_L}{\omega} = 0.354H$

Power factor of the Load, $\cos\phi = \frac{R}{Z} = 0.83$ Lag

Numerical Example 2

Question:

The load connected to a three phase supply comprises three similar coils connected in star. The line current is 25 A, the real and apparent powers are 11KW, 20 KVA. Find the line voltage, resistance, and reactance of each coil. If the coils are connected in delta, find the line current and power taken.

Solution :

Case1: Balanced Star connected Load

Given Data:

Line current, $I_L = 25A$

Three phase Active Power, $P_{3\text{-phase}} = 11KW$

Three phase Apparent Power, $S_{3\text{-phase}} = 20KVA$

Calculations:

$S_{3\text{-phase}} = \sqrt{3} * V_L * I_L = 20KVA$

Hence, $V_L = 461.88V$

Since balanced star connected load,

$I_{ph} = I_L = 25A$; $V_{ph} = \frac{V_L}{} = 266.66V$

$\sqrt{3}$

Impedance per phase, Z = $\frac{V_{ph}}{I_{ph}}$ = 10.66Ω

$P_{3\text{-phase}}$ = 11KW = 3*I_{ph}^2*R; Hence, R = 5.86Ω

Inductive reactance per phase, $X_L = \sqrt{(Z^2 - R^2)}$ = 8.905Ω

Case2: Same Load reconnected as Delta Load across same supply

Since same supply, V_L remains same and since same load, Z, R & L in each phase remain same.

Since balanced delta connected load, $V_{ph} = V_L$ = 461.88V

Phase current, $I_{ph} = \frac{V_{ph}}{Z}$ = 43.33A

Line current, $I_L = \sqrt{3} * I_{ph}$ = 75.04A

Power drawn, $P_{3\text{-phase}} = 3 * I_{ph}^2 * R$ = 33KW

Apparent Power, $S_{3\text{-phase}} = \sqrt{3} * V_L * I_L$ = 60KVA