Lecture 41

2. It is observed that first phase voltage in a balanced star system is $100\sin(\omega t+10^{o})$V.Express all the three phase voltages and all the three line voltages in both time form and phasor form

Solution:

Given: $v_{RN}(t) = 100\sin(\omega t+10^{\circ})$V

In a balanced 3ϕ system, second phase voltage lags first phase voltage by 120° & Third phase voltage lags first phase voltage by 240°.

$\therefore\ v_{YN}(t) = 100\sin(\omega t+10^{\circ}-120^{\circ})$

$= 100\sin(\omega t-110^{\circ})$V

$v_{BN}(t) = 100\sin(\omega t+10^{\circ}-240^{\circ})$

$= 100\sin(\omega t-230^{\circ})$V

Each line voltage is $\sqrt{3}$ Vph and leads corresponding phase voltage by 30°.

Since $v_{RN}(t) = 100\sin(\omega t+10^{\circ})$

$\Rightarrow v_{RY}(t) = \sqrt{3}\times 100\sin(\omega t+10^{\circ}+30^{\circ})$

$= 173.20\sin(\omega t+40^{\circ})$V

Similarly 2nd line voltage lags 1st line voltage by 120° & 3rd line voltage lags 1st line voltage by 240°.

Hence $v_{YB}(t) = \sqrt{3} \times 100 \sin(\omega t + 40^\circ - 120^\circ)$

$= 173.20 \sin(\omega t - 80^\circ) V$

$v_{BR}(t) = \sqrt{3} \times 100 \sin(\omega t + 40^\circ - 240^\circ)$

$= 173.20 \sin(\omega t - 200^\circ) V$

Phasor form of voltages

Phase voltages

$$\bar{V}_{RN} = \frac{100 \angle 0^\circ}{\sqrt{2}}$$

$$\bar{V}_{YN} = \frac{100 \angle -110^\circ}{\sqrt{2}}$$

$$\bar{V}_{BN} = \frac{100 \angle -230^\circ}{\sqrt{2}}$$

Line voltages

$$\bar{V}_{RY} = \frac{173.20 \angle 40^\circ}{\sqrt{2}}$$

$$\bar{V}_{YB} = \frac{173.20 \angle -80^\circ}{\sqrt{2}}$$

$$\bar{V}_{BR} = \frac{173.20 \angle -200^\circ}{\sqrt{2}}$$