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6th May, 2023

assign 5 1. i) 3-ϕ $I_L = 30\angle -30^\circ$ A

Star $V_L = 400\angle 0^\circ$ V $\quad V_{ph} = \frac{400}{\sqrt{3}} = 230.94$

$$Z = \frac{V_{ph}}{I_{ph}} = \frac{230.94\angle 0^\circ}{30\angle -30^\circ} = 7.698\angle 30^\circ\ \Omega$$

ii) Total Power $= \sqrt{3} V_L I_L \cos\phi$

$= \sqrt{3}(30)(400)\cos 30^\circ = 18000$ W

ass. 6. 1. 3ϕ $R = 20\Omega$

Δ conn $L = 0.4$ H $\quad X_L = 314(0.4) = 125.6\ \Omega$

$V_L = 440$ V, 50Hz

~~$V_{ph} = 230.94$~~ $V_{ph} = 440$ V

$Z = 20 + j(125.6)\ \Omega = 127.18\angle 80.95$

$I_{ph} = \frac{V_{ph}}{Z} = \frac{230.94}{127.18} = $ ~~1.8~~ 1.81 A

$I_L =$

Active Power $P_{3\text{-}\phi} = \sqrt{3} V_L I_L \cos\phi$

$= \sqrt{3}(400)(1.81)\cos(80.95)$

$I_{ph} = \frac{400}{127.18} = 3.145$

$I_L = 3.145(\sqrt{3}) = 5.45$

$P = \sqrt{3}(440)(5.45)\cos(80.95)$

$= 652.9$

1. 3-ϕ, Δ $R = 20\Omega$

$L = 0.4$

$V_L = V_{ph} = 440$ V, 50Hz

$X_L = 125.6\ \Omega$

$Z = 20 + j125.6$

$= 127.18\angle 80.95$

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$Z = \frac{V_{ph}}{I_{ph}}$, $I_{ph} = \frac{V_{ph}}{Z} = \frac{440}{127.18} = 3.46$

$I_L = \sqrt{3}(3.46) = 5.99$

Active Power $P_{3-\phi} = \sqrt{3} V_L I_L \cos\phi$

$= \sqrt{3}(440)(5.99)\cos(80.95)$

$= 718.05$ W

Reactive Power $Q_{3-\phi} = \sqrt{3} V_L I_L \sin\phi$

$= \sqrt{3}(440)(5.99)\sin(80.95)$

$= 4508.16$ W

ass 8 :- $W_1 : W_2 = 4 : 1$

$\phi = \cos\left(\tan^{-1}\left(\frac{\sqrt{3}(W_2 - W_1)}{(W_1 + W_2)}\right)\right) = \tan^{-1}\left(\frac{\sqrt{3}(3)}{5}\right) = 46.102$

$\phi = \cos(46.102) = 0.693$

ass 9 :- $W_1 = W_2 = 50$ kW

$W_1 + W_2 = 100$ kW -①

now p.f $= \cos\left(\tan^{-1}\left(\frac{\sqrt{3}(W_2 - W_1)}{W_1 + W_2}\right)\right)$

p.f = 0.866

$\frac{1}{\sqrt{3}} = \frac{\sqrt{3}(W_2 - W_1)}{W_1 + W_2}$

$W_1 + W_2 = 3(W_2 - W_1)$

$\Rightarrow 3(W_2 - W_1) = 100$

$W_2 - W_1 = 33.33$ -②

$2W_2 = 133.33$

$W_2 = 66.67$ W

$W_1 = 33.33$ W

Q8. 1. Δ 3-ϕ $Z = 8 - j6\ \Omega = 10\angle -36.87°$

$Z = R - jX_c$, $V_L = 230V$, 50Hz

$R = 8\Omega$ $V_{ph} = 230$

$X_c = 6\Omega$ $C = \frac{1}{314(6)} = 5.3 \times 10^{-4}\ F$

i) I_L ii) p.f iii) $Q_{3-\phi}$

$I_L = \frac{V_{ph}}{I_{ph}}$ Z $I_{ph} = \frac{V_{ph}}{Z} = \frac{230}{10} = 23$

$I_L = \sqrt{3}(23)$

$= 39.831$

$= 39.83\angle 36.87$

ii) p.f $= \cos(36.87) = 0.799 = 0.8$

iii) $S = \sqrt{3}\, V_L I_L \sin\phi$

$= \sqrt{3}\,(230)(39.83)\sin(36.87)$

$=$ _____

3. 3-ϕ Δ or Y $I_L = I_{ph}$

$V_{ph} = \frac{V_L}{\sqrt{3}}$

$V_L = 400V$, 50Hz

$V_{ph} = 230.94V$ $P_1 = 3kW$ $P_2 = 1kW$

$R = ?$ $C = ?$

$pf = \cos\left(\tan^{-1}\left(\frac{\sqrt{3}(w_2 - w_1)}{w_1 + w_2}\right)\right)$

$= 0.755$

$\phi = 40.89°$

$Z = \frac{V_{ph}}{I_{ph}}$

$4000 = \sqrt{3}\,(400)\, I_L \cos(0.755)$

$I_L = 7.647$

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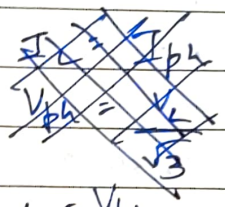
$Z = 30.2 \angle -40.89^\circ$

$= 22.83 - j\,19.769$

A $\quad X_C$

$C = \frac{1}{314(19.769)} = 161\ \mu F$

4. 3-ϕ Δ



$I_L = \sqrt{3} I_{ph}$

$V_{ph} = V_L$

~~$V_{ph} = 115.47\ V$~~

$V_L = 200\ V = V_{ph}$

$Z = 14 - j14\ \Omega \quad = 19.79 \angle -45^\circ$

P = ? S = ?

~~$I_L = I_{ph} = \frac{115.47}{19.79} = 5.834\ A$~~

$Z = \frac{V_{ph}}{I_{ph}}$

$I_{ph} = \frac{200 \angle 45}{19.79} = 10.10 \angle 45$

$I_{ph_1} = 10.10 \angle 45^\circ$

$I_{ph_2} = 10.1 \angle 45 - 120^\circ = 10.1 \angle -75$

$I_{ph_3} = 10.1 \angle -75 - 120 = 10.1 \angle -195$

$I_{L_1} = 10.1(\sqrt{3}) \angle 45 - 30 = 17.5 \angle 15$

$I_{L_2} = 17.5 \angle -75 - 30 = 17.5 \angle -105$

$I_{L_3} = 17.5 \angle -195 - 3 = 17.5 \angle -225^\circ$

ph = 0.707 (lead)

$P_T = \sqrt{3} V_L I_L \cos\phi$

$= \sqrt{3}(200)(17.5)(0.707)$

$= 4.286\ kW$

$Q = \sqrt{3} V_L I_L \sin\phi$

$= 4.286\ kW$

$S = \sqrt{P^2 + Q^2} = 6.06\ kW$

5. $P = 150\,kW$ 3-ϕ star $I_L = I_{ph}$

$I_L = 100\,A$ (lead) $V_{ph} = \frac{1100}{\sqrt{3}}$

$V_L = 1100\,V$, 50 Hz $= 635.08$

circuit constants : ? R, C

$$150 \times 10^3 = \sqrt{3}(1100)(100)\cos\phi$$

$$\cos\phi = 0.787$$

$$\phi = 38.06°$$

$$Z = \frac{V_{ph}}{I_{ph}} = \frac{635.08}{100} = 6.3508 \angle 38.06$$

$$Z = 5.00 - j\underset{X_C}{3.92}$$

$$C = \frac{1}{314(3.92)} = 812.4\,\mu F$$

6. $V_L = 400\,V$ 3-ϕ Δ : I_L, I_{ph}

o/p $P = 25$ HP $V_L = V_{ph}$

$\eta = 87\%$ $I_L = \sqrt{3}\, I_{ph}$

pf $= 0.82$

$$0.87 = \frac{25 \times 746}{P.I}$$

21436.78

$P = 23151.73$ W

$$23151.78 = \sqrt{3}(400)(I_L)(0.82)$$

$I_L = 40.752$ $37.73\,A$

$$I_{ph} = \frac{37.73}{\sqrt{3}} = 21.78\,A$$

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7. 3-ϕ $V_L = 2600\,V = V_{ph}$
Δ $P = 300 \times 10^3\,W$
$I_L = \sqrt{3} I_{ph}$ $I_L = 100\,A$ (lead) $I_{ph} = 57.74$

$3 \times 10^5 = \sqrt{3}\,(2000)(100)\cos\phi$

$\cos\phi = 0.866$

$\phi = 30°$

$Z = \frac{V_{ph}}{I_{ph}} = \frac{2600}{57.74} = 34.64 \angle -30°$

$Z = 29.999 - j\,17.32$
$R \quad X_c$

$C = \frac{1}{314(17.32)} = 183.87\,\mu F$

8. $Z = 20 + j15\,\Omega$ = ~~19.32 +~~
$= 25 \angle 36.86°$ 3-ϕ Y con

$V_{ph} = \frac{400}{\sqrt{3}} = 230.94$

$V_L = 400$

$I_{ph} = \frac{230.94}{25} = 9.24\,A$

$P = \sqrt{3} V_L I_L \cos\phi$
$= \sqrt{3}(400)(9.24)\cos(36.86°)$ = ~~5121.99~~
$= 2515\,W$

9. $W_1 = 8kw$ $W_2 = -0.3kw$

$pf = \cos\left(\tan^{-1}\left(\sqrt{3}\frac{(W_2 - W_1)}{W_1 + W_2}\right)\right)$ = ~~0.576~~ 0.427

$\phi = 64.72$

$P = W_1 + W_2$
$= 7.2\,kW$

$Q = \sqrt{3} V_L I_L \sin\phi$
$Q = 16.86\,[\sin(64.22)]$
$Q = 15.24\,VAR$

$7.2 = \sqrt{3} V_L I_L \cos\phi$

$\frac{7.2}{0.427} = \sqrt{3} V_L I_L$

$= 16.86\,W$

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10. $V_L = 200\,V$ 3-ϕ star star $V_{ph} = 115.47$

$Z = 9 - j5$

$= 10.29 \angle -29.05°$ $\phi = -29.05$

$I_{ph} = \frac{115.47}{10.29} = 11.23 = I_L$

$P_1 = V_L I_L \cos(30 + \phi)$

$= 200(11.23)\cos(30 - 29.05)$

$= 2243.69\ W$

$P_2 = V_L I_L \cos(30 - \phi)$

$= 1154.06\ W$

11. 3-ϕ Δ $V_L = 400\,V$

50Hz $I_L = 27.72$; $I_{ph} = \frac{27.72}{\sqrt{3}} = 16.00$

$P = 15360$

$15360 = \sqrt{3}(400)(27.72)\cos\phi$

$\cos\phi = 0.799$

$\phi = 36.88°$

$Z = \frac{V_{ph}}{I_{ph}} = \frac{400}{16} = 25$

$Z = 25 \angle 36.88°$

$= 19.99 + j15.00$

$R = 20\,\Omega$ $X_L = 15$

$L = \frac{15}{314} = 0.0477 = 47.7\,mH$