任意三相电路，不论负载是星形还是角形连接

有功功率
$$P = U_A I_A \cos\varphi_A + U_B I_B \cos\varphi_B + U_C I_C \cos\varphi_C$$
$$= 3U_P I_P \cos\varphi = 1.5 U_m I_m \cos\varphi = \sqrt{3} U_l I_l \cos\varphi$$

无功功率
$$Q = U_A I_A \sin\varphi_A + U_B I_B \sin\varphi_B + U_C I_C \sin\varphi_C$$
$$= 3U_P I_P \sin\varphi = 1.5 U_m I_m \sin\varphi = \sqrt{3} U_l I_l \sin\varphi$$

视在功率
$$S = \sqrt{P^2 + Q^2} = 3U_P I_P = 1.5 U_m I_m = \sqrt{3} U_l I_l$$

三相电路对称时
$$U_A = U_B = U_C = U_P = U_m / \sqrt{2}$$
$$I_A = I_B = I_C = I_P = I_m / \sqrt{2}$$
$$\varphi_A = \varphi_B = \varphi_C = \varphi$$

对称三相功率因数
$$\lambda = \frac{P}{S} = \cos\varphi$$

三相平衡制
$$p = u_A i_A + u_B i_B + u_C i_C = 3U_P I_P \cos\varphi = \sqrt{3} U_l I_l \cos\varphi = P$$

对称三相电路的功率 例题

例1 某对称三相负载各相阻抗为$Z=(6+j8)\Omega$，接于线电压为380V的对称三相电源上，分别计算负载为星形和角形接法时负载相电压、相电流及消耗的平均功率。

解： 功率因数为 $\lambda = \cos\varphi = \dfrac{6}{\sqrt{6^2+8^2}} = 0.6$

星形 $U_l = 380\text{V} = 220\sqrt{3}\text{V}$

$U_P = \dfrac{380\text{V}}{\sqrt{3}} = 220\text{V}$

$I_P = I_l = \dfrac{U_P}{|Z|} = \dfrac{220\text{V}}{10\Omega} = 22\text{A}$

$P = 3U_P I_P \lambda =$

$3\times 220\times 22\times 0.6 = 8712\text{ W}$

$U_{P\triangle} = \sqrt{3}U_{PY}$

$I_{P\triangle} = \sqrt{3}I_{PY}$

$P_\triangle = 3P_Y$

角形 $U_l = U_P = 380\text{V} = 220\sqrt{3}\text{ V}$

$I_P = \dfrac{U_P}{|Z|} = \dfrac{380\text{V}}{10\Omega} = 38\text{A}$,

$I_l = \sqrt{3}I_P = \sqrt{3}\times 22\sqrt{3}\text{ A} = 66\text{A}$

$P = 3U_P I_P \lambda =$

$3\times 380\times 38\times 0.6 = 26136\text{W}$