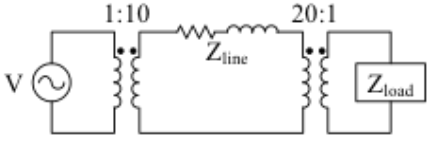
5/26 (五) 1000 B>b ① note ② calculator ③ iPad ④ Book ⑤ No cheating !

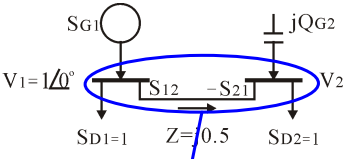
2022/04/19 電力工程導論　姓名_____學號_____

1. (10) Compare DC power system with AC power system.
2. (10) Compare AC single phase voltage with three phase voltage.
3. (10) A generator will be paralleled with a running AC power system. Which conditions are required for paralleling?
4. (10) Plotting the generator phasor diagrams under (a) lagging power factor; (b) unity power factor; (c) leading power factor.

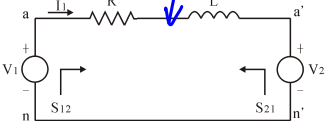
5.(20) A simple power system is shown in figure. This system contains a 480V(0^0)/60Hz generator connected to an ideal 1:10 step-up transformer, a transmission line, an ideal 20:1 step-down transformer, and a load. The impedance of the transmission line is Z_{line} =20+j60Ω, and Z_{load} =8.66+j5Ω. The base values for this system are chosen to be 480V and 10kVA at the generator.
(a) Find the base voltage, current, impedance, and apparent power at every point in the power system.
(b) Convert this system to its per-unit equivalent circuit.
(c) Find the power supplied to the load in this system.
(d) Find the power lost in the transmission line



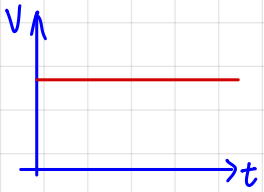
6.(20) S_{G1}:V_1=1∠0°，S_{D1}=1，jQ_{G2} :V_2=?，S_{D2}=1，Z=j0.5, (a)Find Q_{G2} for $|V_2|$=1 (b) and ∠V_2 ?(c) If Q_{G2}=0, could be supplied load S_{D2} ?(d) and ∠V_2 ?



7. (20) Find (a) S12 and S21; (b) P12 and –P21; (c) Q12 and Q21.
(Z=R+jωL, $V_1=|V_1|e^{j\theta 1}$，$V_2=|V_2|e^{j\theta 2}$，$Z=|Z|\,e^{j\angle Z}$，$\theta_{12}=\theta_1-\theta_2$)



1. DC power system

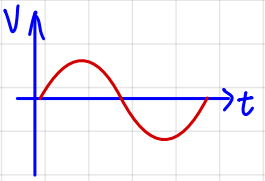


① 電感短路 電容开路 ⇒ 無虛功

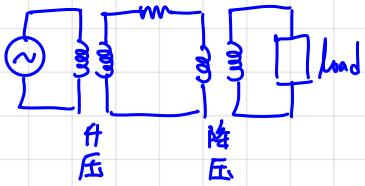
② 傳統的無法升降压，近代靠电力电子

AC power system

單相 / 三相

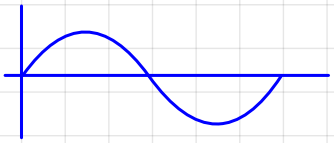


① 電感、電容不可忽略 ⇒ 產生虛功



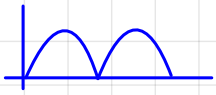
② 利用变压器升压 → 減少傳輸線損耗
再降压提供負載使用

2. 單相



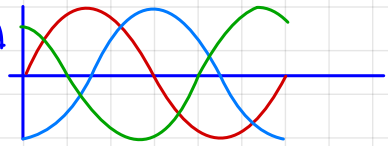
$V(t) = V_m \sin(\omega t)$ (cos)

cons: power 脈动



cos 圖不同

三相



$V_a(t) = V_m \sin(\omega t)$ (cos)

$V_b(t) = V_m \sin(\omega t - 120°)$

$= V_m \sin(\omega t - \frac{2}{3}\pi)$

$V_c(t) = V_m \sin(\omega t + 120°)$

$-240°$

pros: constant power

$\sqrt{3}\, V_{line\text{-}to\text{-}line}\, I_{line\text{-}to\text{-}line} \cos\theta = 3 V_{相} I_{相} \cos\theta$

> 10kW 要做三相！

3. 併網 ① frequency : f

$\omega = 2\pi f$ (角速度) 相同

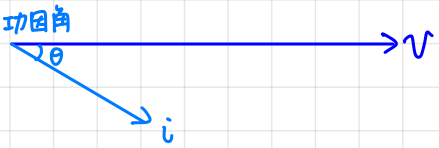
② 角度 相同 (same phase)

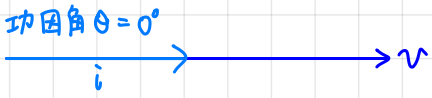
③ 相序相同 (看到 a→b→c)

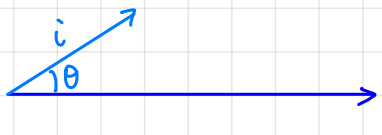
④ V_m 相同

4. (a) lagging power factor 落後功因　(b) unity power factor 單位功因　(c) leading power factor 領先功因

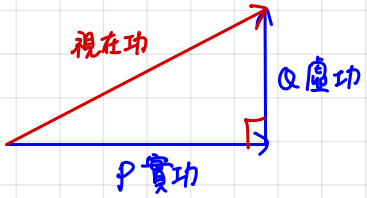
相量圖在同步座標



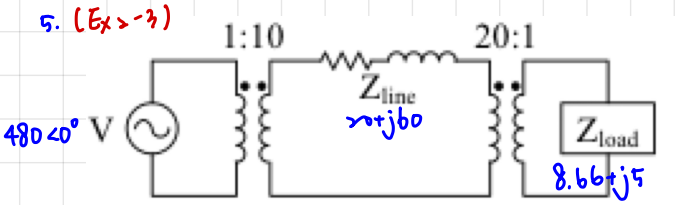




電費計算



5. (Ex 2-3)



標么基準 480V, 10kVA

(a) 基準 (V. i. 阻抗. 視在功)

(b) 簡化成標么圖

(c) 負載的實功率

(d) 傳輸線損

發電机 $V_b = 480$, $S_b = 10kVA \Rightarrow \frac{480}{480} = 1\angle 0°$ 標么

傳輸線 $V_b = 4800$, $S_b = 10kVA$

$\Rightarrow S_b = V_b I_b \Rightarrow I_b = \frac{10kVA}{4800}$

$\Rightarrow Z_b = \frac{V_b}{I_b} = \frac{4800}{\frac{10kVA}{4800}}$

阻抗 $\frac{x0+jb0}{Z_b}$

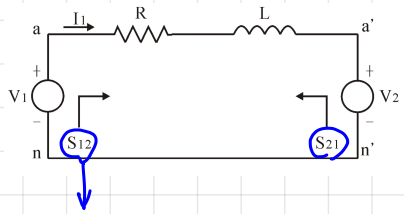
負載 $V_b = x40$, $S_b = 10kVA \Rightarrow I_b = \frac{10kVA}{x40}$

$\Rightarrow Z_b = \frac{V_b}{I_b} = \frac{x40}{\frac{10kVA}{x40}}$

阻抗 $\frac{8.66+j5}{Z_b}$

* 真實 power $\Rightarrow$ * 標么值 (?) reference to 設義

7.



視在功

(a) S_{12} & S_{21}

(b) P_{12} & $-P_{21}$

(c) Q_{12} & Q_{21}

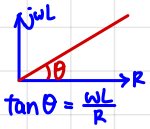
power system ch2 2.26

$S_{12} = V_1 \cdot I_1^*$

$Z = R + jwL$, $V_1 = |V_1| e^{j\theta_1}$, $V_2 = |V_2| e^{j\theta_2}$, $\theta_{12} = \theta_1 - \theta_2$

$Z = |Z| e^{j\angle\theta}$

$|Z| = \sqrt{R^2 + (wL)^2}$



$\tan\theta = \frac{wL}{R}$

$S_{21} = V_2 (-I_1)^*$

$I_1 = \frac{V_1 - V_2}{Z}$

$S_{12} = V_1 \left(\frac{V_1 - V_2}{Z}\right)^*$

$= V_1 \left(\frac{V_1^* - V_2^*}{Z^*}\right)$

$S_{21} = V_2 \left(\frac{V_2 - V_1}{Z}\right)^*$

$= V_2 \left(\frac{V_2^* - V_1^*}{Z^*}\right) \neq S_{12}$

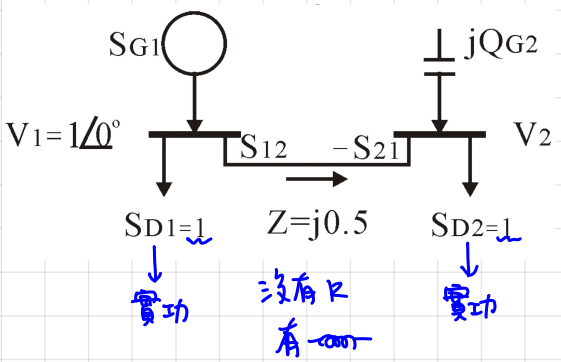
$P_{12} = -P_{21}$, $Q_{12} \neq Q_{21}$

assume $R = 0$?

* $V_1 V_1^* = |V_1|^2 = a^2 + b^2$

$(a+jb)(a-jb) = a^2 + b^2$

b. power system ch2. ex2.14



實功　沒有R　有

① jQ_{G2}, V_2 = ?

(a) $|V_2|=1$

(b) $\angle V_2$ = ?

(c) $Q_{G2}=0$, 可維持電力供應. 負載 $S_{D2}=1$?

(d) $\angle V_2$ = ?

bus2: 流進虛功 = 流出虛功

流進實功 = 流出實功

$P_{12}=S_{D_2}=1$

$=\frac{|V_1||V_2|}{X}\sin\theta_{12}$

$Z=j0.5=jX=jwL$　已知 $\begin{cases}|V_2|=1\\ |V_2|=1'\end{cases}$, $X=0.5$

$P_{12}=-P_{21}=\left(\frac{|V_1||V_2|}{X}\right)\sin\theta_{12}$

$\theta_{12}=\frac{|V_1|^2}{X}-\frac{|V_1||V_2|}{X}\cos\theta_{12}$

$\theta_{21}=\frac{|V_2|^2}{X}-\frac{|V_1||V_2|}{X}\cos\theta_{12}$

$S_{21}=-1$

$=\frac{|V_2|^2 j}{0.5}-\frac{j|X||V_2|e^{j\theta_{12}}}{0.5}$

虛功=0, 只有實功

$\Rightarrow \sin\theta_{12}=0.5$

$\Rightarrow \theta_{12}=30°$

① $V_2=1\angle -30°$

$je^{-j\theta_{12}}=j(\cos\theta_{12}-j\sin\theta_{12})=j\cos\theta_{12}$ 虛功

$+\sin\theta_{12}$ 實功

$-\frac{|V_2|}{0.5}\times\sin\theta_2=-1$

$\Rightarrow 1^2 j=j|V_2|\cos\theta_{12}=0$