2023.7.3

{ 直流 (0Hz)
  交流 (60Hz or 50Hz) Japan

① 平面，空間，正交

② Fourier，直流 & 交流正交
  sin，cos 正交
  sinn，cosn 正交

③ 多項式 1，x，x^2，…，正交

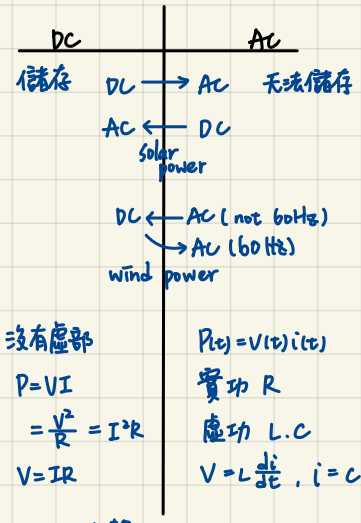
電路學 ① DC分析：voltage，current，power
② AC分析：voltage，current，power { 實部，bandwidth / 虛部
電力工程：電能傳送

電力電子：電能轉換 { DC→DC / DC→AC / AC→DC / AC→AC（只用變壓器不能改變頻率）

電子學：① 二極體 —▷|— 不可控 switch（順逆偏）

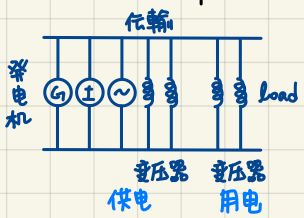
②  可控 switch
線性放大

電機機械：利用磁場轉換能量
① 發电机：机→电
② motor：电→机
③ 变压器：电→电



沒有虛部
$P=VI$
$=\frac{V^2}{R}=I^2R$
$V=IR$

$P(t)=V(t)i(t)$
實功 R
虛功 L.C
$V=L\frac{di}{dt}$，$i=C\frac{dv}{dt}$



motion：① 直線 $F=ma$

② 旋轉 $\tau=J\alpha$

功率：$P=VI$

功：$J=VI\times t$

$=F\times x$ (力×位移)

$=\tau\times\theta$ (力矩 torque × 角度)

馬力 ≈ 735.49875 W (J/s)

≈ 736 W

電機機械 利用磁場 4大公式

創造磁場 1. 安培定律：$\oint H\,dl = Ni$ (磁場強度、長度、導體圈數、電流)

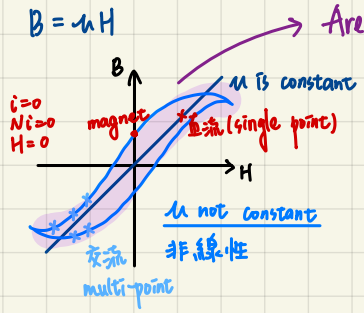
2. 法拉第：$e_{ind} = N\frac{d\phi}{dt} = L\frac{di}{dt}$ (感應電壓、圈數、磁通)

(變壓器) 時變的磁場，感應電壓

from same person

3. 馬達 (電→動)：$\vec{F} = (i\vec{l}\times\vec{B})$ (力、電流、導體長度、磁通密度(磁場))，$B=\frac{\phi}{A}$

4. 發電机 (動→電)：$V = (\vec{v}\times\vec{B})\cdot\vec{l}$ (voltage、velocity)



* 法拉第：$e_{ind} = -N\frac{d\phi}{dt} = -L\frac{di}{dt}$ (感應電壓、圈數、磁通)，↑ 對抗

磁路 (non-linear → linear)	電路 (linear)
$\mathcal{F} = Ni = \phi\mathcal{R}$，$\mathcal{R}=\frac{l}{\mu A}$	$V=iR$ ($v=iR$ (ac))，$R=\frac{l}{\mu A}$
導磁 ≠ 導電	
① 串聯 ② 並聯	① 串聯 ② 並聯
	③ KVL ④ KCL

not accurate：

因為磁路非線性

但用線性去分析

accurate：Maxwell software

$V = L\frac{di}{dt} = Lsi = L(jw)i$，$s=\frac{d}{dt}$

$i = C\frac{dv}{dt} = CsV = C(jw)V$

$\frac{d\sin(wt)}{dt}$

$= \frac{d\sin(wt)}{dwt}\times\frac{dwt}{dt}$

$= \cos(wt)\times w = \sin(wt+90^\circ)\times w = j\sin(wt)\times w \Rightarrow \frac{d}{dt} = s = jw$

$w = 2\pi f$ (rad/s)

60Hz → $w = 377$ rad/s

60kHz → $w = 377k$ rad/s

EX1-10: The linear dc machine shown in Figure 1-27 has a battery voltage of 120V, an internal resistance of 0.3Ω, and a magnetic flux density of 0.1T.

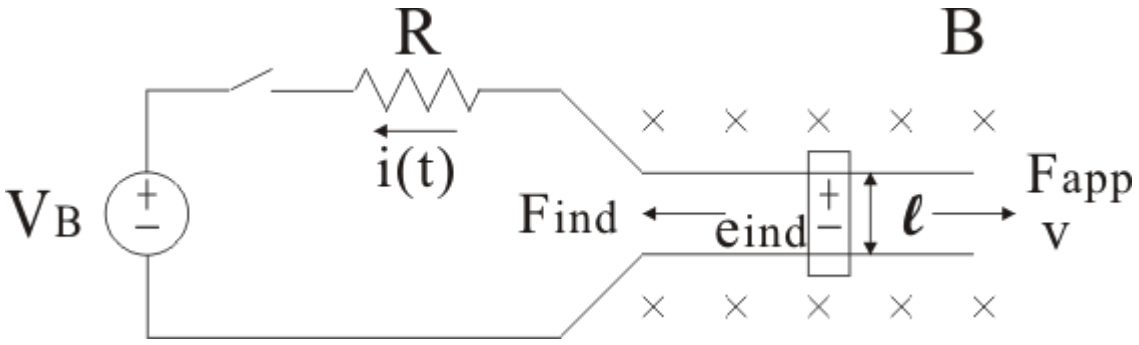
(a) What is this machine's maximum starting current? What is its steady-state velocity at no load ?

(b) Suppose that a 30-N force pointing to the right were applied to the bar. What would the steady-state speed be? How much power would the battery be producing or consuming? Is this machine acting as a motor or as a generator ?

(c) Now suppose a 30-N force point to the left were applied to the bar. What would the new steady-state speed be ? Is this machine a motor or a generator now ?

(d) Assume that a force pointing to the left is applied to the bar. Calculate speed of the bar as a function of the force for values from 0 N to 50 N in 10N-steps. Plot the velocity of the bar versus the applied force.

(e) Assume that the bar is unloaded and that it suddenly runs into a region where the magnetic field is weakened to 0.08T. How fast will the bar go now?



Ex 1-10

$V_{外} = iR + (\vec{v} \times \vec{B}) \cdot \vec{L}$

① $120 = i \times 0.3 + 0_{起动}$

$\Rightarrow i = \frac{120}{0.3} = 400A$

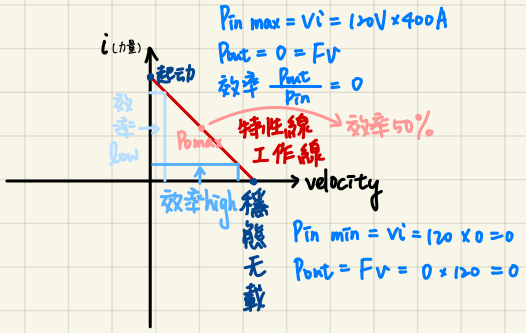
$F = iL \times B$

$= 400 \times 10m \times 0.1T = 400$ newton

② $i = 0$. $V_{外} = (\vec{v} \times \vec{B}) \cdot \vec{L}$

$120 = v \times 0.1 \times 10m$

$v = 120 m/s = 432 \frac{km}{hr}$



$P_{in\ max} = Vi = 120V \times 400A$

$P_{out} = 0 = Fv$

效率 $\frac{P_{out}}{P_{in}} = 0$

$P_{in\ min} = Vi = 120 \times 0 = 0$

$P_{out} = Fv = 0 \times 120 = 0$

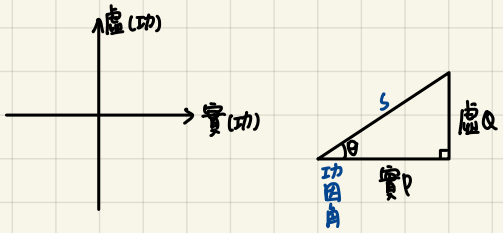
電路元件 ① 被动：不能改變 freq.

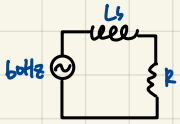
$R \cdot V = iR$

$L \cdot V = L\frac{di}{dt}$

$C: i = C\frac{dv}{dt} \Rightarrow V = \frac{1}{C}\int i dt$

② 主动：可以改变 freq.





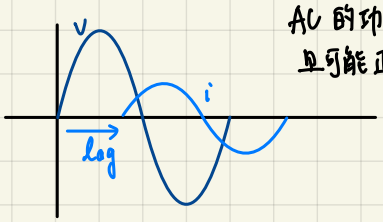
$V = \bar{i}(Ls + R)$

$s = jw = j \times 377$

$s = P + jQ$

$P = s\cos\theta$

$Q = s\sin\theta$



AC 的功非 constant

且可能正負交替

DC (0Hz) 大小 相同　　AC：freq 相同 (零誤差)

微調 { ϕ 相角 / 振幅 } 大致相同