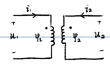
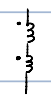
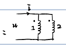
耦合电感



$$\begin{cases} u_1 = L_1\frac{di_1}{dt} + M\frac{di_2}{dt} \\ u_2 = L_2\frac{di_2}{dt} + M\frac{di_1}{dt} \end{cases}$$ 左图中 $M>0$

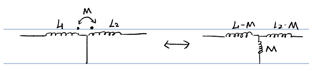
串： 同名相连反接，异名相连顺接　$u=(L_1+L_2+2M)\frac{di}{dt}$　顺接 $M>0$

并：

$$\begin{cases} u = L_1\dot{i}_1 + M\dot{i}_2 \\ u = M\dot{i}_1 + L_2\dot{i}_2 \\ i = i_1 + i_2 \end{cases} \Rightarrow u = \frac{L_1L_2 - M^2}{L_1+L_2-2M}\frac{di}{dt}$$

Tips：用感纳

T型电感去耦等效



Definations：激励、响应、零输入/零状态响应

一般解法：特征根 + 通解 + 稳态 + 初始状态

冲激响应：列微分方程 + 积分，attention：之后 i、u 会耗散

$$h(t) = \frac{1}{C}e^{-\frac{t}{RC}}(\varepsilon(t)) \quad \text{or} \quad \frac{1}{L}e^{-\frac{R}{L}t}(\varepsilon(t))$$

卷积：$y(t) = \int_0^t f(\tau)h(t-\tau)d\tau$，$h(t)$ 为冲激响应，$f(t)$ 为一任意输入

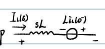
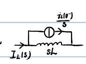
Trick：阶跃响应 $\xrightarrow{\text{求导}}$ 冲击响应 $\xrightarrow{\text{卷积}}$ 任意响应

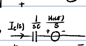
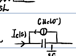
三要素法 $f(t) = f(+\infty) + (f(0)-f(+\infty))e^{-\frac{t}{\tau}}$　$\tau = \frac{L}{R}$ or RC　在运算中亦能用到

本质：$\tau\cdot\dot{x} + x = C$ 特征根

Laplace　$\mathcal{L}(f'(t)) = sF(s) - f(0^-)$

☆多看 significant

$\Rightarrow U_L(s) = LsI_L(s) - Li_L(0^-)$ 即  or 

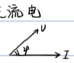
$U_C(s) = \frac{1}{sC}I_C(s) + \frac{u_C(0^-)}{s}$ 即  or  (完全不用)

互感情况同理，按正负号叠 $Mi(0^-)$

阻抗、导纳

固有频率数 = 独立储能元件数，零固有频率(反之)

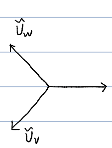
交流电



$P = UI\cos\varphi$　$Q = UI\sin\varphi$ (var)

共轭匹配下负载获得最大功率；品质因数 $Q = \frac{\omega L}{R}$ (不考)

分子为0 — 串联谐振，分母为0 — 并联谐振

三相  正序　相电压、线电压、相电流、线电流

$$\dot{U}_{NN'} = \frac{\frac{U_u}{Z_u} + \frac{U_v}{Z_v} + \frac{U_w}{Z_w}}{\frac{1}{Z_u} + \frac{1}{Z_v} + \frac{1}{Z_w}}$$

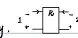
$$P = P_u + P_v + P_w = \underbrace{3U_pI_p}_{\text{相}}\cos\varphi = \sqrt{3}\underbrace{U_LI_L}_{\text{线}}\cos\varphi = \underbrace{P_1 + P_2}_{\text{二瓦特计法}} = \overbrace{P_1 + P_2 + P_3}^{\text{三相四线}} = 3P_1$$

直流相关

集中参数电路 $d \ll \lambda$，书：$d < \lambda/10$

流出为 +1

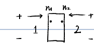
基本回路、割集

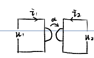
Tellegen's Theorem $\sum u i' = 0$，Particularly，

$$\begin{cases} \hat{u}_1 i_1 + R\hat{i}i + \hat{u}_2 i_2 = 0 \\ u_1\hat{i}_1 + Ri\hat{i} + u_2\hat{i}_2 = 0 \end{cases}$$

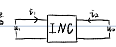
正弦、阶跃、脉冲、冲激、斜波 $r(t)$

放大器：虚短不成立 1、A有限 2、理想运放时，开环或正反馈 3、饱合

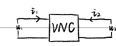
变压器  $u_1/n_1 = u_2/n_2$，$n_1i_1 + n_2i_2 = 0$ ($n_1i_1 = -n_2i_2$)

回转器：

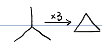
$$\begin{cases} u_1 = -\alpha i_2 \\ u_2 = \alpha i_1 \end{cases}$$ 不耗能不储能　"$\frac{\alpha^2}{R}$"

负转换器 

$$\begin{cases} i_1 = i_2 \\ u_1 = u_2 \end{cases}$$



$$\begin{cases} i_1 = -i_2 \\ u_1 = -u_2 \end{cases}$$



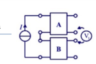
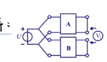
互易定理：电压源与理想电流表互换示数不变（仅适用于无源线性非时变）

端口特性：$\vec{u} = A\vec{i} + \vec{b}$

significant

R、G、H、$\hat{H}$、A、$\hat{A}$ $\longrightarrow$ $\begin{bmatrix} u_1 \\ i_1 \end{bmatrix} = T(\text{or } A)\begin{bmatrix} u_2 \\ -i_2 \end{bmatrix}$　$\hat{A} = A^{-1}$

$\begin{bmatrix} u_1 \\ i_2 \end{bmatrix} = H\begin{bmatrix} i_1 \\ u_2 \end{bmatrix}$　$\hat{H} = H^{-1}$

有效性测试　左串： 左并：　$V=0$？

串-并联：$H = H^a + H^b$；并串联 $\hat{H}$；级联 $A = A^aA^b$

互易：$h_{12} = -h_{21}$，$r_{12} = r_{21}$，$g_{21} = g_{12}$，$a_{11}a_{22} - a_{12}a_{21} = 1$

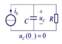
Tricks：

1、三要素法 $t=0^+$、$+\infty$ 易求，τ 复杂时列微分方程解特征根 — 选择题先不管 τ

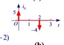
2、三相交流电、放大器用节点法

题：

1、**例**：在图(a)电路中，$u_C(0_-)=0$，C=2F，R=1Ω，电流源波形如图(b)所示，试求u_C。



(a)



(b)

解：RC并联电路单位冲激响应为

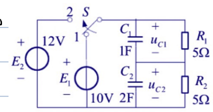
$$h(t)=\frac{1}{C}e^{-t/RC}\varepsilon(t)$$

根据线性非时变电路的齐次性、可加性和非时变特性，响应u_C为

$$u_C=5h(t)-4h(t-2)=\frac{5}{C}e^{-\frac{t}{RC}}\varepsilon(t)-\frac{4}{C}e^{-\frac{t-2}{RC}}\varepsilon(t-2)$$

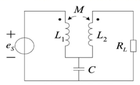
15

2、求τ



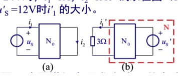
$\frac{15}{2}$

3、**例3**：电路如图，已知：L_1=1H，L_2=4H，M=2H，C=1F。试求含有互感的网络中负载电阻R_L上的零状态响应电流的拉氏变换。



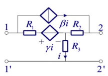
$$\frac{2s+\frac{1}{s}}{s+(s^2+1)R_L}E$$

4、**例4**：图中N_0为线性无源电阻电路，图（a）中，当u_S=24V时，i_1=8A，i_2=6A。试求在图（b）中，当u'_S=12V时i'_1 的大小。



多种方法： 1.5A

5、**例5**：如图所示电路，电阻R_1、R_2、R_3已知，试问：当β与γ取何种关系时，此电路是互易电路。



$\gamma=(R_1+R_2)\beta$