

# 電學公式：

|                |                                                                                                                                          |                                 |                                                                                                                                          |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 電流             | $I = \frac{Q}{t} = \frac{V}{R} \quad [\text{A}]$                                                                                         | 導體電阻                            | $R = \rho \frac{\ell}{A} \quad [\Omega]$                                                                                                 |
| 電導             | $G = \frac{1}{R} \quad [\text{S}]$                                                                                                       | 克希荷夫定律                          | $\sum I = 0 \quad ; \quad \sum V = 0$                                                                                                    |
| 電阻溫度係數         | $R_2 = R_1 \{1 + \alpha_1 (t_2 - t_1)\} \quad [\Omega]$<br>$\frac{R_1}{R_2} = \frac{\frac{1}{\alpha_0} + t_1}{\frac{1}{\alpha_0} + t_2}$ | 電阻連接                            | 串聯 $R_{eq} = R_1 + R_2 + R_3 + \dots [\Omega]$<br>並聯 $R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots} [\Omega]$ |
| 直流電功率          | $P = VI \quad [\text{W}]$                                                                                                                | 電熱或電能                           | $W = Pt \quad [\text{J}]$                                                                                                                |
| 磁動勢            | $mmf = IN = \phi S \quad [\text{A}]$                                                                                                     | 電力電能                            | $kWh = P(\text{kW}) \times t(\text{h})$                                                                                                  |
| 磁通密度           | $B = \frac{\phi}{a} = \mu H \quad [\text{T}]$                                                                                            | 磁場強度                            | $H = \frac{F}{\ell} \quad [\text{A/m}]$                                                                                                  |
| 磁阻             | $S = \frac{\ell}{\mu a} \quad [\text{A/Wb}]$                                                                                             | 絕對導磁率                           | $\mu = \mu_0 \mu_r$<br>$\mu_0 = 4\pi \times 10^{-7} \quad [\text{H/m}]$                                                                  |
| 電磁作用力          | $F = BI\ell \sin \theta \quad [\text{N}]$                                                                                                | 導體感應電動勢                         | $E = Bv\ell \sin \theta \quad [\text{V}]$                                                                                                |
| 線圈感應電動勢        | $E = -N \frac{\Delta \phi}{\Delta t} = -L \frac{\Delta I}{\Delta t} \quad [\text{V}]$                                                    | 電感                              | $L = N \frac{\phi}{I} \quad [\text{H}]$                                                                                                  |
| 自感電動勢          | $E_1 = -L \frac{\Delta I}{\Delta t} \quad [\text{V}]$                                                                                    | 互感電動勢                           | $E_2 = -M \frac{\Delta I}{\Delta t} \quad [\text{V}]$                                                                                    |
| 線圈儲能量          | $W = \frac{1}{2} LI^2 \quad [\text{J}]$                                                                                                  | 互感                              | $M = N_2 \frac{\phi_{12}}{I_1} ; M = N_1 \frac{\phi_{21}}{I_2} \quad [\text{H}]$                                                         |
| 線圈耦合           | $k = \frac{M}{\sqrt{L_1 L_2}} ; L = L_1 + L_2 \pm 2M \quad [\text{H}]$                                                                   | 電場強度                            | $E = \frac{V}{d} \quad [\text{V/m}]$                                                                                                     |
| 絕對介電常數         | $\epsilon = \epsilon_0 \epsilon_r ; \epsilon_0 = 8.85 \times 10^{-12} \quad [\text{F/m}]$                                                | 電通密度                            | $D = \epsilon E \quad [\text{C/m}^2]$                                                                                                    |
| 電容器電容量         | $C = \frac{Q}{V} \quad [\text{F}]$                                                                                                       | 電容器並聯容量                         | $C_{eq} = C_1 + C_2 + C_3 + \dots [\text{F}]$                                                                                            |
| 電容器串聯容量        | $C_{eq} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots} [\text{F}]$                                                    | 多層電容電容量                         | $C = \frac{\epsilon(n-1)A}{d} \quad [\text{F}]$                                                                                          |
| 電容器儲存能量        | $W = \frac{1}{2} CV^2 \quad [\text{J}]$                                                                                                  | 直流暫態電路的時間常數                     | $RL$ 電路 $T = \frac{L}{R} [\text{s}] ; RC$ 電路 $T = RC [\text{s}]$                                                                         |
| R-L 串聯電路的暫態電流值 | $i = I \left(1 - e^{-\frac{Rt}{L}}\right) \quad [\text{A}]$                                                                              | R-C 串聯電路的暫態電流值                  | $i = I e^{-\frac{t}{RC}} \quad [\text{A}]$                                                                                               |
| 正弦波角速度         | $\omega = 2\pi f \quad [\text{rad/s}]$                                                                                                   | 正弦波電動勢                          | $v = V_m \sin \theta = 2\pi BANn \sin \theta \quad [\text{V}]$                                                                           |
| 正弦波頻率          | $f = \frac{1}{T} = np \quad [\text{Hz}]$                                                                                                 | 正弦波峰值                           | $V_m = \sqrt{2} V = \frac{V_{av}}{2} \pi \quad [\text{V}]$                                                                               |
| 感抗             | $X_L = 2\pi fL = \omega L \quad [\Omega]$                                                                                                | 容抗                              | $X_C = \frac{1}{2\pi fC} = \frac{1}{\omega C} \quad [\Omega]$                                                                            |
| 阻抗             | $Z = \sqrt{R^2 + (X_L - X_C)^2} \quad [\Omega]$                                                                                          | RLC 電路功率因數 p.f. ( $\cos \phi$ ) | $p.f. = \frac{R}{Z}$ (串聯) ; $p.f. = \frac{Z}{R}$ (並聯)                                                                                    |
| 有功功率           | $P = VI \cos \phi \quad [\text{W}]$                                                                                                      | 交流功率三角形                         | $S^2 (\text{視在}) = P^2 (\text{有功}) + Q^2 (\text{無功})$                                                                                    |

|                             |                                                                                                                                                                                |                             |                                                                                                                                                                    |
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| 無功功率                        | $Q = VI \sin \phi \quad [\text{VA}_r]$                                                                                                                                         | 視在功率                        | $S = IV \quad [\text{VA}]$                                                                                                                                         |
| RLC 串聯電路                    | $Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2} \quad [\Omega]$                                                                                                 | RLC 並聯電路                    | $Z = \frac{1}{\sqrt{\left(\frac{1}{R}\right)^2 + \left(\frac{1}{\omega L} - \omega C\right)^2}} \quad [\Omega]$                                                    |
| 諧振頻率                        | $f_r = \frac{1}{2\pi\sqrt{LC}} \quad [\text{Hz}]$                                                                                                                              | 品質因數                        | $Q = \frac{L \text{或} C \text{端電壓}}{\text{供電電壓}} = \frac{2\pi f_r L}{R}$ ; 或 $Q = \frac{1}{2\pi f_r CR}$                                                           |
| 共基極電流<br>放大倍數               | $\alpha = \frac{\Delta I_c}{\Delta I_e} \quad ; \alpha = \frac{\beta}{1 + \beta}$                                                                                              | 共發射極電流<br>放大倍數              | $\beta = \frac{\Delta I_c}{\Delta I_b} \quad ; \beta = \frac{\alpha}{1 - \alpha}$                                                                                  |
| 電壓放大倍數                      | $A_v = \frac{V_o}{V_i}$                                                                                                                                                        | 電流放大倍數                      | $A_i = \frac{I_o}{I_i}$                                                                                                                                            |
| 半波整流直流壓                     | $V_{dc} = 0.45V \quad [\text{V}]$                                                                                                                                              | 全波整流直流壓                     | $V_{dc} = 0.9V \quad [\text{V}]$                                                                                                                                   |
| 變壓器初級與次級的<br>關係             | $\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$                                                                                                                          | 變壓器初級與次級的<br>功率             | $V_1 I_1 = V_2 I_2$<br>當效率 $\eta = 100\%$                                                                                                                          |
| 變壓器的感應電壓                    | $E = 4.44 f N B_m A \quad [\text{V}]$                                                                                                                                          | 惠斯登電橋平衡                     | 相對兩電阻相乘=另相對兩電阻相乘                                                                                                                                                   |
| 電流表分流器                      | $R_s I_s = R_m I_m$                                                                                                                                                            | 電壓表倍增器                      | $\frac{V_m}{R_m} = \frac{V_R}{R} = I_m$                                                                                                                            |
| 單相電功率                       | $P = V_p I_p \cos \phi \quad [\text{W}]$                                                                                                                                       | 三相電功率                       | $P = \sqrt{3} V_L I_L \cos \phi = 3 V_p I_p \cos \phi \quad [\text{W}]$                                                                                            |
| 三相平衡的電功率<br>二瓦特表法           | $P = P_1 + P_2 \quad [\text{W}]$<br>$P_1 = V_L I_L \cos(30^\circ - \phi) \quad [\text{W}]$<br>$P_2 = V_L I_L \cos(30^\circ + \phi) \quad [\text{W}]$                           | 二瓦特表法的<br>電抗功率及<br>功率因數計算   | $P_r = \sqrt{3} (P_1 - P_2) \quad [\text{VA}_R]$<br>$p.f. = \cos \left[ \tan^{-1} \sqrt{3} \left( \frac{P_2 - P_1}{P_2 + P_1} \right) \right]$                     |
| $\Delta \rightarrow Y$ 阻抗換算 | $Z_a = \frac{Z_{ab} Z_{ca}}{Z_{ab} + Z_{bc} + Z_{ca}} ;$<br>$Z_b = \frac{Z_{ab} Z_{bc}}{Z_{ab} + Z_{bc} + Z_{ca}} ;$<br>$Z_c = \frac{Z_{bc} Z_{ca}}{Z_{ab} + Z_{bc} + Z_{ca}}$ | $Y \rightarrow \Delta$ 阻抗換算 | $Z_{ab} = \frac{Z_a Z_b + Z_b Z_c + Z_c Z_a}{Z_c} ;$<br>$Z_{bc} = \frac{Z_a Z_b + Z_b Z_c + Z_c Z_a}{Z_a} ;$<br>$Z_{ca} = \frac{Z_a Z_b + Z_b Z_c + Z_c Z_a}{Z_b}$ |
| 直流發電機的<br>電動勢               | $E = \frac{2Z}{c} \cdot \frac{Np}{60} \cdot \phi = V + I_a R_a \quad [\text{V}]$                                                                                               | 直流電動機電壓                     | $V = E + I_a R_a$                                                                                                                                                  |
| 直流電動機轉速                     | $N = \frac{V - I_a R_a}{k\phi} \quad [\text{rpm}]$                                                                                                                             | 直流電動機轉矩                     | $T = 0.318 \frac{I_a}{c} \cdot Zp\phi \quad [\text{N}\cdot\text{m}]$                                                                                               |
| 同步發電機轉速                     | $N = \frac{60f}{p} \quad [\text{rpm}]$                                                                                                                                         | 感應電動機轉速                     | $N_r = (1 - S)N \quad [\text{rpm}]$                                                                                                                                |
| 電動機效率                       | $\eta = \frac{P_o}{P_i} \times 100\%$                                                                                                                                          | 轉子頻率                        | $f_r = s f \quad [\text{Hz}]$                                                                                                                                      |

## 詞冠 Prefix

|      |                     |                    |                    |                    |                 |                 |                 |
|------|---------------------|--------------------|--------------------|--------------------|-----------------|-----------------|-----------------|
| 名稱   | 皮 pico              | 納 nano             | 微 micro            | 毫 milli            | 千 kilo          | 兆 Mega          | 吉 Giga          |
| 符號   | p                   | n                  | $\mu$              | m                  | k               | M               | G               |
| 大小倍數 | $1 \times 10^{-12}$ | $1 \times 10^{-9}$ | $1 \times 10^{-6}$ | $1 \times 10^{-3}$ | $1 \times 10^3$ | $1 \times 10^6$ | $1 \times 10^9$ |