ELTK1100 FORMULAS

Ohm's Law

$$I = \frac{V_T}{R}$$

Voltage Drop

$$V_x = I_x * R_x$$

Series circuits (sub-circuits)

$$I_T = I_1 = I_2 = I_3 = ...$$

$$R_T = R_1 + R_2 + R_3 + ...$$

$$I_T = \frac{V_T}{R_T}$$

KVL

$$V_T = V_1 + V_2 + V_3 + ...$$

Voltage Division (for series resistors)

$$V_x = \frac{R_x}{R_T} * V_T$$

Current

$$I = \frac{q}{t}$$

$$1\ C = 6.25 * 10^{18}\ electrons$$

Power

$$P = V_T I = I^2 R = \frac{V_T^2}{R}$$

$$1\ hp = 746\ W$$

Energy

$$Energy = P\ t$$

$$Cost = Energy * \frac{cost}{kW \bullet h}$$

P in kW
t in h
Energy in kW•h

Heat

$$Q = M\ C\ \Delta T \qquad \Delta T = T_2 - T_1$$

$$Efficiency = \frac{Q}{Heat\ Produced} * 100\%$$

$$Heat\ Produced = \frac{P\ t}{4.187}$$

P in W
t in s

Parallel circuits (sub-circuits)

$$V_T = V_1 = V_2 = V_3 = ...$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...$$

$$I_T = \frac{V_T}{R_T}$$

KCL

$$I_T = I_1 + I_2 + I_3 + ...$$

Current Division (for parallel resistors)

$$I_x = \frac{R_{eq}}{R_x} * I_T$$

Current Division (for 2 parallel resistors)

$$I_x = \frac{Opposite}{Sum} * I_T$$

Two resistors in parallel

$$R_1 \parallel R_2 = \frac{R_1 * R_2}{(R_1 + R_2)}$$

n equal resistors in parallel

$$R_T = \frac{R}{n}$$

Conductance

$$G = \frac{1}{R}$$

$$G_T = G_1 + G_2 + G_3 + ...$$

$$I_T = V_T G_T$$

Conductor Resistance

$$R = \frac{\rho \ell}{A}$$

Metric *English*

$1\ mil = 0.001''$

$$A = \frac{\pi d^2}{4} \qquad A = d^2$$

$1\ CM = 1\ mil^2$

Magnetomotive Force

$$F_M = N I$$

Magnetic Flux

$$\phi = \frac{F_M}{R_M}$$

Dynamic Induction

$$V_{IND} = N B \ell v$$

Static Induction

$$V_{IND} = N \frac{\Delta\phi}{\Delta t} \qquad \Delta\phi = \phi_1 - \phi_2$$

Inductance

$$L = \frac{N^2}{R_M}$$

$$V_{IND} = L \frac{\Delta I}{\Delta t} \qquad \Delta I = I_1 - I_2$$

Series $L_T = L_1 + L_2 + L_3 + \ldots.$

Parallel $\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \ldots.$

Effect of Temperature on Resistance

$$R_{T_2} = \frac{\left(1 + \alpha_0 T_2\right)}{\left(1 + \alpha_0 T_1\right)} * R_{T_1}$$

$$R_T = \left(1 + \alpha_0 T\right) * R_0$$

Error

$$\%\ Error = \left| \frac{Actual - Measured}{Actual} \right| * 100\%$$

Battery Capacity

$$Capacity = Discharge\ Rate * time$$

Batteries

Series $E_T = S E$ $r_T = S r$

Parallel $E_T = E$ $r_T = \frac{r}{P}$

Series/Parallel $E_T = S E$ $r_T = \frac{S r}{P}$

$V_T = E_T - I_T r_T$