

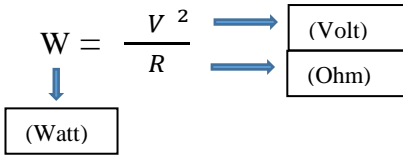
## FONKSİYONLAR

$$y = f(x_1, x_2, x_3, \dots) \quad \frac{dy}{dx_i} = \frac{d f(x_i)}{dx_i} = C_i$$

$$U_y = \sqrt{\sum \left( \frac{dy}{dx_i} \right) \cdot U_i^2}$$

$$\frac{dy}{dx_i} = C_i \Rightarrow U_y = \sqrt{\sum C_i^2 \cdot U_i^2}$$

### 1. ÖRNEK (Güç)



$$\frac{dw}{dv} = \frac{2V}{R} \quad U_w^2 = \left( \frac{2V}{R} \right)^2 \cdot U_v^2 + \left( -\frac{V^2}{R^2} \right)^2 \cdot U_R^2$$

$$\frac{dw}{dR} = -\frac{V^2}{R^2} \quad \frac{U_w^2}{w^2} = \frac{\frac{4V^2}{R^2} \cdot U_v^2 + \frac{V^4}{R^4} \cdot U_R^2}{\left( \frac{V^2}{R} \right)^2}$$

$$\frac{U_w^2}{w^2} = \frac{4V^2}{R^2} \cdot \frac{R^2}{V^4 V^2} U_v^2 + \frac{V^4}{R^4} \cdot \frac{R^2}{V^4} \cdot U_R^2$$

$$\frac{U_w^2}{w^2} = \frac{4 \cdot U_v^2}{V^2} + \frac{U_R^2}{R^2} = \left( \frac{2 \cdot U_v}{|V|} \right)^2 + \left( \frac{U_R}{|R|} \right)^2$$

İşlem kolaylığı için % Relatif belirsizliğe çevrilmesi iyi olacaktır.

$$\% \frac{U_w}{W} = \sqrt{\left( \frac{2 \cdot U_v \cdot 100}{|V|} \right)^2 + \left( \frac{U_R \cdot 100}{|R|} \right)^2}$$

## SAYISAL ÖRNEK

$$V = 5 \text{ v} \qquad U_v = 0,01 \text{ v}$$

$$R = 5 \ \Omega \qquad U_R = 0,01 \ \Omega$$

$$W = 5 \text{ watt} \qquad U_w = ?$$

$$\% \frac{U_w}{W} = \sqrt{\left(\frac{2 \cdot (0,01) \cdot 100}{5}\right)^2 + \left(\frac{0,01 \cdot 100}{5}\right)^2}$$

$$\% \frac{U_w}{W} = \sqrt{\left(\frac{4}{25}\right) + \left(\frac{1}{25}\right)} = \% \frac{1}{\sqrt{5}} = 0,45$$

$$\% \frac{U_w}{W} = 0,45 \Rightarrow U_w = \frac{5 \cdot 0,45}{100} = 0,0225 \text{ w}$$

$$= \mathbf{5 \text{ w} \pm 0,023}$$

## 2. ÖRNEK (Normalize Hacim)

$$V_0 = C \cdot \frac{V_m \cdot P_b}{T_m}$$

- $V_0$  = Normalize Hacim Nm<sup>3</sup>  
 $V_m$  = Gazometre Hacmi m<sup>3</sup>  
 $P_b$  = Gazometre Basıncı  
 $T_m$  = Gazometre Sıcaklığı

$$\frac{dV_0}{dV_m} = \frac{C \cdot P_b}{T_m}$$

$$U_{V_0} = \sum \sqrt{\left(\frac{dV_0}{dx_i}\right) \cdot U_i^2}$$

$$\frac{dV_0}{dP_b} = \frac{C \cdot V_m}{T_m}$$

$$U_{V_0}^2 = \left[\frac{C \cdot P_b}{T_m}\right]^2 \cdot U_{V_m}^2 + \left[\frac{C \cdot V_m}{T_m}\right]^2 \cdot U_{P_b}^2 + \left[\frac{C \cdot V_m \cdot P_b}{T_m^2}\right]^2 \cdot U_{T_m}^2$$

$$\frac{dV_0}{dT_m} = -\frac{C \cdot V_m \cdot P_b}{T_m^2}$$

$$\frac{U_{V_0}^2}{V_0^2} = \frac{\frac{C^2 \cdot P_b^2}{T_m^2} \cdot U_{V_m}^2 + \frac{C^2 \cdot V_m^2}{T_m^2} \cdot U_{P_b}^2 + \frac{C^2 \cdot V_m^2 \cdot P_b^2}{T_m^4} \cdot U_{T_m}^2}{\left[\frac{C \cdot V_m \cdot P_b}{T_m}\right]^2}$$

$$\frac{U_{V_0}^2}{V_0^2} = \frac{C^2 \cdot P_b^2}{T_m^2} \cdot \frac{T_m^2}{C^2 \cdot V_m^2 \cdot P_b^2} \cdot U_{V_m}^2 + \frac{C^2 \cdot V_m^2 \cdot T_m^2}{T_m^2 \cdot C^2 \cdot V_m^2 \cdot P_b^2} \cdot U_{P_b}^2 + \frac{C^2 \cdot V_m^2 \cdot P_b^2 \cdot T_m^2}{T_m^4 \cdot C^2 \cdot V_m^2 \cdot P_b^2} \cdot U_{T_m}^2$$

$$\frac{U_{V_0}^2}{V_0^2} = \frac{U_{V_m}^2}{V_m^2} + \frac{U_{P_b}^2}{P_b^2} + \frac{U_{T_m}^2}{T_m^2}$$

% Relatif belirsizliği bulmakta kolaylık sağlar.

$$\% \frac{U_v}{V_0} = \sqrt{\left(\frac{U_{V_0}}{V_m} \cdot 100\right)^2 + \left(\frac{U_{P_b}}{P_b} \cdot 100\right)^2 + \left(\frac{U_{T_m}}{T_m} \cdot 100\right)^2}$$

### 3. ÖRNEK İDEAL GAZ DENKLEMİ

$$P = \frac{n.R.T}{V}$$

P (Basınç), V (Hacim) ve T (Sıcaklığa) bağlıdır.

$$\frac{dP}{dT} = \frac{n.R}{V}$$

$$Up^2 = \left[\frac{n.R}{V}\right]^2 \cdot Ut^2 + \left[-\frac{n.R.T}{V^2}\right]^2 \cdot Uv^2$$

$$\frac{dP}{dV} = -\frac{n.R.T}{V^2}$$

$$\frac{Up^2}{P^2} = \frac{\frac{n^2 \cdot R^2}{V^2} \cdot Ut^2 + \frac{n^2 \cdot R^2 \cdot T^2}{V^4} \cdot Uv^2}{\left[\frac{n.R.T}{V}\right]^2}$$

$$\frac{Up^2}{P^2} = \frac{\cancel{n^2} \cdot \cancel{R^2}}{\cancel{V^2}} \cdot \frac{\cancel{V^2}}{\cancel{n^2} \cdot \cancel{R^2} \cdot T^2} Ut^2 + \frac{\cancel{n^2} \cdot \cancel{R^2} \cdot \cancel{T^2}}{\cancel{V^4}} \cdot \frac{\cancel{V^2}}{\cancel{n^2} \cdot \cancel{R^2} \cdot \cancel{T^2}} \cdot Uv^2$$

$$\frac{Up^2}{P^2} = \frac{Ut^2}{|T|^2} \cdot \frac{Uv^2}{|V|^2}$$

$$\% \frac{Up}{P} = \sqrt{\left(100 \cdot \frac{Ut}{T}\right)^2 + \left(100 \cdot \frac{Uv}{V}\right)^2}$$