

Lampiran

3.7.1.1 Hasil pengukuran pada modul tugas ahir

a. Perhitungan pengukuran injeksi 2 unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$\sum xi = 2 \text{ ml}$ (Hasil penjumlahan 10 data)

$n = 10$

$2 \text{ unit} = 0.2 \text{ ml}$

Ditanya :

\bar{x} = rata-rata....?

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{2}{10} = 0.2 \text{ ml}$$

2) Koreksi

$$\text{Koreksi} = \bar{X} - Y$$

Diketahui:

$$\bar{X} = 0,2 \text{ ml}$$

$$Y = 0,2 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= \bar{X} - Y \\ &= 0.2 - 0.2 = 0 \text{ ml} \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 0.2 \text{ ml}$$

$$\bar{X} = 0.2 \text{ ml}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{0,2 - 0,2}{0,2} \times 100 = 0\%$$

b. Perhitungan pengukuran injeksi 4 unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$\sum xi = 4 \text{ ml}$ (Hasil penjumlahan 10 data)

$n = 10$

$4 \text{ unit} = 0,4 \text{ ml}$

Ditanya :

\bar{x} = rata-rata....?

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{4}{10} = 0,4 \text{ ml}$$

2) Koreksi

$$\text{Koreksi} = \bar{X} - Y$$

Diketahui:

$$\bar{X} = 0,4 \text{ ml}$$

$$Y = 0,4 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= \bar{X} - Y \\ &= 0,4 - 0,4 = 0 \text{ ml} \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 0,4 \text{ ml}$$

$$\bar{X} = 0,4 \text{ ml}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{0,4 - 0,4}{0,4} \times 100 = 0\%$$

c. Perhitungan pengukuran injeksi 6 unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$\sum xi = 6 \text{ ml}$ (Hasil penjumlahan 10 data)

$$n = 10$$

$$6 \text{ unit} = 0,6 \text{ ml}$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{6}{10} = 0,6 \text{ ml}$$

2) Koreksi

$$\text{Koreksi} = Y - \bar{X}$$

Diketahui:

$$\bar{X} = 0,6 \text{ ml}$$

$$Y = 0,6 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= Y - \bar{X} \\ &= 0,6 - 0,6 = 0 \text{ ml} \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 0,6 \text{ ml}$$

$$\bar{X} = 0,6 \text{ ml}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{0,6 - 0,6}{0,6} \times 100 = 0\%$$

d. Perhitungan pengukuran injeksi 8 unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$\sum xi = 8 \text{ ml}$ (Hasil penjumlahan 10 data)

$$n = 10$$

$$8 \text{ unit} = 0,8 \text{ ml}$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{8}{10} = 0,8 \text{ ml}$$

2) Koreksi

$$\text{Koreksi} = \bar{X} - Y$$

Diketahui:

$$\bar{X} = 0,8 \text{ ml}$$

$$Y = 0,8 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= \bar{X} - Y \\ &= 0,8 - 0,8 = 0 \text{ ml} \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 0,8 \text{ ml}$$

$$\bar{X} = 0,8 \text{ ml}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{0,8 - 0,8}{0,8} \times 100 = 0\%$$

e. Perhitungan pengukuran injeksi 10 unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$$\sum xi = 9,8 \text{ ml (Hasil penjumlahan 10 data)}$$

$$n = 10$$

$$1 \text{ unit} = 1 \text{ ml}$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{9,8}{10} = 0,98 \text{ ml}$$

2) Koreksi

Koreksi $Y - \bar{X}$

Diketahui:

$$\bar{X} = 1 \text{ ml}$$

$$Y = 0,98 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= Y - \bar{X} \\ &= 1 - 0,98 = 0,02 \text{ ml} \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 1 \text{ ml}$$

$$\bar{X} = 0,98 \text{ ml}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{1 - 0,98}{1} \times 100 = 2\%$$

f. Perhitungan pengukuran injeksi 12 unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$$\sum xi = 11,95 \text{ ml (Hasil penjumlahan 10 data)}$$

$$n = 10$$

$$12 \text{ unit} = 1,2 \text{ ml}$$

Ditanya :

\bar{x} = rata-rata....?

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{11,95}{10} = 1,195 \text{ ml}$$

4) Koreksi

Koreksi $Y - \bar{X}$

Diketahui:

$$\bar{X} = 1,195 \text{ ml}$$

$$Y = 1,2 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= Y - \bar{X} \\ &= 1,2 - 1,195 = 0,005\text{ml} \end{aligned}$$

5) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 1,2\text{ml}$$

$$\bar{X} = 1,195\text{ml}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{1,2 - 1,195}{1,2} \times 100 = 0,4\%$$

g. Perhitungan pengukuran injeksi 14unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$$\sum xi = 13,9 \text{ ml (Hasil penjumlahan 10 data)}$$

$$n = 10$$

$$14\text{unit} = 1,4\text{ml}$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{13,9}{10} = 1,39 \text{ ml}$$

2) Koreksi

$$\text{Koreksi} = Y - \bar{X}$$

Diketahui:

$$\bar{X} = 1,39 \text{ ml}$$

$$Y = 1,4 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= Y - \bar{X} \\ &= 1,4 - 1,39 = 0,01\text{ml} \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 1,2 \text{ ml}$$

$$\bar{X} = 1,195 \text{ ml}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{1,4 - 1,39}{1,4} \times 100 = 0,7\%$$

h. Perhitungan pengukuran injeksi 16 unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$$\sum xi = 15,8 \text{ ml (Hasil penjumlahan 10 data)}$$

$$n = 10$$

$$16 \text{ unit} = 1,6 \text{ ml}$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{15,8}{10} = 1,58 \text{ ml}$$

2) Koreksi

$$\text{Koreksi} = Y - \bar{X}$$

Diketahui:

$$\bar{X} = 1,58 \text{ ml}$$

$$Y = 1,6 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\text{Koreksi} = Y - \bar{X}$$

$$= 1,6 - 1,58 = 0,02 \text{ ml}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 1,2 \text{ ml}$$

$$\bar{X} = 1,195ml$$

Ditanya:

% *Error*...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{1,6 - 1,58}{1,4} \times 100 = 1,2\%$$

i. Perhitungan pengukuran injeksi 18unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$\sum xi = 17,8$ ml (Hasil penjumlahan 10 data)

$$n = 10$$

$$18unit = 1,8ml$$

Ditanya :

\bar{x} = rata-rata...?

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{17,8}{10} = 1,78 \text{ ml}$$

2) Koreksi

$$\text{Koreksi} = Y - \bar{X}$$

Diketahui:

$$\bar{X} = 1,78ml$$

$$Y = 1,8 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= Y - \bar{X} \\ &= 1,8 - 1,78 = 0,02ml \end{aligned}$$

3) % *Error*

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 1,8ml$$

$$\bar{X} = 1,78ml$$

Ditanya:

% *Error*...?

Jawab

$$\begin{aligned} \% \text{ Error} &= \frac{Y - \bar{X}}{Y} \times 100 \\ &= \frac{1,8 - 1,78}{1,8} \times 100 = 1,1\% \end{aligned}$$

j. Perhitungan pengukuran injeksi 20 unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$\sum xi = 19,8$ ml (Hasil penjumlahan 10 data)

$n = 10$

20 unit = 2ml

Ditanya :

\bar{x} = rata-rata....?

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{19,8}{10} = 1,98 \text{ml}$$

2) Koreksi

$$\text{Koreksi} = Y - \bar{X}$$

Diketahui:

$$\bar{X} = 1,98 \text{ ml}$$

$$Y = 2 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= Y - \bar{X} \\ &= 2 - 1,98 = 0,02 \text{ml} \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 2 \text{ ml}$$

$$\bar{X} = 1,98 \text{ml}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{2 - 1,98}{2} \times 100 = 1\%$$

k. Perhitungan pengukuran injeksi 22 unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum x_i}{n}$$

Diketahui :

$$\sum x_i = 21,8 \text{ ml (Hasil penjumlahan 10 data)}$$

$$n = 10$$

$$22 \text{ unit} = 2,2 \text{ ml}$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum x_i}{n}$$

$$\bar{x} = \frac{21,8}{10} = 2,18 \text{ ml}$$

4) Koreksi

$$\text{Koreksi} = Y - \bar{X}$$

Diketahui:

$$\bar{X} = 2,18 \text{ ml}$$

$$Y = 2,2 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= Y - \bar{X} \\ &= 2,2 - 2,18 = 0,02 \text{ ml} \end{aligned}$$

5) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 2 \text{ ml}$$

$$\bar{X} = 1,98 \text{ ml}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{2,2 - 2,18}{2,2} \times 100 = 1\%$$

1. Perhitungan pengukuran injeksi 24 unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum x_i}{n}$$

Diketahui :

$$\sum x_i = 24 \text{ ml (Hasil penjumlahan 10 data)}$$

$$n = 10$$

$$24 \text{ unit} = 2,4 \text{ ml}$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{2,4-2,4}{10} = 2,4 \text{ ml}$$

2) Koreksi

$$\text{Koreksi} = Y - \bar{X}$$

Diketahui:

$$\bar{X} = 2,4 \text{ ml}$$

$$Y = 2,4 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= Y - \bar{X} \\ &= 2,4 - 2,4 = 0 \text{ ml} \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 2,4 \text{ ml}$$

$$\bar{X} = 2,4 \text{ ml}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{2,4 - 2,4}{2,4} \times 100 = 0\%$$

m. Perhitungan pengukuran injeksi 26 unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$$\sum xi = 25,95 \text{ ml (Hasil penjumlahan 10 data)}$$

$$n = 10$$

$$26 \text{ unit} = 2,6 \text{ ml}$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{25,95}{10} = 2,595 \text{ ml}$$

2) Koreksi

$$\text{Koreksi} = Y - \bar{X}$$

Diketahui:

$$\bar{X} = 2,595 \text{ ml}$$

$$Y = 2,6 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= Y - \bar{X} \\ &= 2,6 - 2,595 = 0,005 \text{ ml} \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 2,6 \text{ ml}$$

$$\bar{X} = 2,595 \text{ ml}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{2,6 - 2,595}{2,6} \times 100 = 0,2\%$$

n. Perhitungan pengukuran injeksi 28 unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$$\sum xi = 28 \text{ ml (Hasil penjumlahan 10 data)}$$

$$n = 10$$

$$20 \text{ unit} = 2 \text{ ml}$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{28}{10} = 2,8 \text{ ml}$$

2) Koreksi

$$\text{Koreksi} = Y - \bar{X}$$

Diketahui:

$$\bar{X} = 2,8 \text{ ml}$$

$$Y = 2,8 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= Y - \bar{X} \\ &= 2,8 - 2,8 = 0 \text{ ml} \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 2,8 \text{ ml}$$

$$\bar{X} = 2,8 \text{ ml}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{2,8 - 2,8}{2,8} \times 100 = 0\%$$

o. Perhitungan pengukuran injeksi 30 unit dengan gelas ukur

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$$\sum xi = 29,6 \text{ ml (Hasil penjumlahan 10 data)}$$

$$n = 10$$

$$30 \text{ unit} = 3 \text{ ml}$$

Ditanya :

\bar{x} = rata-rata....?

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{29,6}{10} = 2,96 \text{ ml}$$

2) Koreksi

$$\text{Koreksi} = Y - \bar{X}$$

Diketahui:

$$\bar{X} = 2,96 \text{ ml}$$

$$Y = 3 \text{ ml}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned}\text{Koreksi} &= Y - \bar{X} \\ &= 3 - 2,96 = 0,04\text{ml}\end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 3 \text{ ml}$$

$$\bar{X} = 2,96\text{ml}$$

Ditanya:

% Error...?

Jawab

$$\begin{aligned}\% \text{ Error} &= \frac{Y - \bar{X}}{Y} \times 100 \\ &= \frac{3 - 2,96}{3} \times 100 = 1,3\%\end{aligned}$$

p. Perhitungan pengukuran kecepatan motor selama proses injeksi manual dan auto dengan Tachometer

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$$\sum xi = 21 \text{ rpm (Hasil penjumlahan 10 data)}$$

$$n = 10$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{21}{10} = 21 \text{ rpm}$$

2) Koreksi

$$\text{Koreksi} = Y - \bar{X}$$

Diketahui:

$$\bar{X} = 21 \text{ rpm}$$

$$Y = 21 \text{ rpm}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned}\text{Koreksi} &= Y - \bar{X} \\ &= 21,21 = 0 \text{ rpm}\end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 21 \text{ rpm}$$

$$\bar{X} = 21 \text{ rpm}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{21 - 21}{21} \times 100 = 0 \%$$

q. Perhitungan pengukuran kecepatan motor selama proses injeksi manual dan auto dengan Tachometer

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$$\sum xi = 2910 \text{ rpm (Hasil penjumlahan 10 data)}$$

$$n = 10$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{2910}{10} = 291 \text{ rpm}$$

2) Koreksi

$$\text{Koreksi} = Y - \bar{X}$$

Diketahui:

$$\bar{X} = 291 \text{ rpm}$$

$$Y = 291 \text{ rpm}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= Y - \bar{X} \\ &= 291 - 291 = 0 \text{ rpm} \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 291 \text{ rpm}$$

$$\bar{X} = 291 \text{ rpm}$$

Ditanya:

% *Error*...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{291 - 291}{291} \times 100 = 0 \%$$

r. Perhitungan tegangan *supply* sebelum bekerja

1) Pengukuran Tegangan 9 V

2) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$\sum xi = 34 \text{ V}$ (Hasil penjumlahan 4 data)

$n = 10$

Ditanya :

\bar{x} = rata-rata....?

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{34}{4} = 8,5 \text{ Volt}$$

2) Koreksi

$$\text{Koreksi} = Y - \bar{X}$$

Diketahui:

$$\bar{X} = 8,5 \text{ volt}$$

$$Y = 9 \text{ volt}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= Y - \bar{X} \\ &= 9 - 8,5 = 0.5 \text{ volt} \end{aligned}$$

3) % *Error*

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 9 \text{ volt}$$

$$\bar{X} = 8,5 \text{ volt}$$

Ditanya:

% *Error*...?

Jawab

$$\begin{aligned} \% \text{ Error} &= \frac{Y - \bar{X}}{Y} \times 100 \\ &= \frac{9 - 8,5}{9} \times 100 = 5,5\% \end{aligned}$$

a) Pengukuran Tegangan 5V

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$\sum xi = 18,8V$ (Hasil penjumlahan 4 data)

$n = 4$

Ditanya :

\bar{x} = rata-rata....?

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{18,8}{4} = 4,7 \text{ Volt}$$

2) Koreksi

$$\text{Koreksi} = \bar{X} - Y$$

Diketahui:

$$\bar{X} = 4,7 \text{ volt}$$

$$Y = 5 \text{ volt}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= \bar{X} - Y \\ &= 4,7 - 5 = 0,03 \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 5 \text{ volt}$$

$$\bar{X} = 4,7 \text{ volt}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{5 - 4,7}{5} \times 100 = 6\%$$

s. Perhitungan tegangan supply sesudah bekerja

a) Pengukuran Tegangan 9 V

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum x_i}{n}$$

Diketahui :

$\sum x_i = 22$ V (Hasil penjumlahan 4 data)

$$n = 4$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum x_i}{n}$$

$$\bar{x} = \frac{22}{4} = 5.5 \text{ Volt}$$

2) Koreksi

$$\text{Koreksi} = \bar{X} - Y$$

Diketahui:

$$\bar{X} = 5.5 \text{ volt}$$

$$Y = 9 \text{ volt}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= \bar{X} - Y \\ &= 5.5 - 9 = 3,5 \text{ volt} \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 5.5 \text{ volt}$$

$$\bar{X} = 9 \text{ volt}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{5.5 - 9}{9} \times 100 = 38.8\%$$

b) Pengukuran Tegangan 5 V

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum x_i}{n}$$

Diketahui :

$\sum x_i = 18.8$ V (Hasil penjumlahan 10 data)

$$n = 4$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{18.8}{4} = 4.7 \text{ Volt}$$

2) Koreksi

$$\text{Koreksi} = \bar{X} - Y$$

Diketahui:

$$\bar{X} = 4.78 \text{ volt}$$

$$Y = 5 \text{ volt}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= \bar{X} - Y \\ &= 4.7 - 5 = 0.3 \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 5 \text{ volt}$$

$$\bar{X} = 4.7 \text{ volt}$$

Ditanya:

% Error...?

Jawab

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

$$= \frac{5 - 4.7}{5} \times 100 = 6 \%$$

t. Perhitungan Tegangan driver motor stepper

a) interval 1 menit

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$$\sum xi = 49 \text{ V (Hasil penjumlahan 10 data)}$$

$$n = 10$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{49}{10} = 4.9 \text{ Volt}$$

2) Koreksi

$$\text{Koreksi} = \bar{X} - Y$$

Diketahui:

$$\bar{X} = 4.9 \text{ volt}$$

$$Y = 9 \text{ volt}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= \bar{X} - Y \\ &= 4.9 - 4.9 = 4.1 \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 9 \text{ volt}$$

$$\bar{X} = 4.9 \text{ volt}$$

Ditanya:

% Error...?

Jawab

$$\begin{aligned} \% \text{ Error} &= \frac{Y - \bar{X}}{Y} \times 100 \\ &= \frac{9 - 4.9}{9} \times 100 = 45.5\% \end{aligned}$$

b) interval 2 menit

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum xi}{n}$$

Diketahui :

$$\sum xi = 48,4 \text{ V (Hasil penjumlahan 10 data)}$$

$$n = 10$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum xi}{n}$$

$$\bar{x} = \frac{48.4}{10} = 4.84 \text{ Volt}$$

2) Koreksi

$$\text{Koreksi} = \bar{X} - Y$$

Diketahui:

$$\bar{X} = 4.84 \text{ volt}$$

$$Y = 9 \text{ volt}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned} \text{Koreksi} &= \bar{X} - Y \\ &= 4.84 - 9 = 4.16 \end{aligned}$$

3) % Error

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 9 \text{ volt}$$

$$\bar{X} = 4.84 \text{ volt}$$

Ditanya:

% Error...?

Jawab

$$\begin{aligned} \% \text{ Error} &= \frac{Y - \bar{X}}{Y} \times 100 \\ &= \frac{9 - 4.84}{9} \times 100 = 46 \% \end{aligned}$$

c) Interval 3 menit

1) Rata-rata

$$\text{Rata-rata } \bar{x} = \frac{\sum x_i}{n}$$

Diketahui :

$$\sum x_i = 46.6 \text{ V (Hasil penjumlahan 10 data)}$$

$$n = 10$$

Ditanya :

$$\bar{x} = \text{rata-rata...?}$$

Jawab :

$$\bar{x} = \frac{\sum x_i}{n}$$

$$\bar{x} = \frac{46.6}{10} = 4.66 \text{ Volt}$$

4) Koreksi

$$\text{Koreksi} = \bar{X} - Y$$

Diketahui:

$$\bar{X} = 4.66 \text{ volt}$$

$$Y = 9 \text{ volt}$$

Ditanya :

Koreksi...?

Jawab :

$$\begin{aligned}\text{Koreksi} &= \bar{X} - Y \\ &= 4.66 - 9 = 4.34\end{aligned}$$

5) % *Error*

$$\% \text{ Error} = \frac{Y - \bar{X}}{Y} \times 100$$

Diketahui:

$$Y = 9 \text{ volt}$$

$$\bar{X} = 4.66 \text{ volt}$$

Ditanya:

% *Error*...?

Jawab

$$\begin{aligned}\% \text{ Error} &= \frac{Y - \bar{X}}{Y} \times 100 \\ &= \frac{9 - 4.66}{9} \times 100 = 48 \%\end{aligned}$$

3.7.1.2 Pembuatan Program Keseluruhan

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <SoftwareSerial.h>
#include <DS3231.h>
#include <EEPROM.h>
LiquidCrystal_I2C lcd(0x27,16,2);
SoftwareSerial BlueSer(5, 6); // RX, TX
DS3231 rtc(SDA, SCL);
const int sw1 = 2;
const int sw2 = 1;
const int sw3 = 0;
const int Up_buttonPin = 3; // the pin that the pushbutton is attached
to
const int Down_buttonPin = 4;
const int buzzer =8;
const int out1 =10; //output ke motor stepper
const int out2 =11;
const int out3 =12;
const int out4 =13;
char l;
String m ;
String n ;
int k ;
int ok = 0;
int next = 0;
int back = 0;
int buttonPushCounter = 2; // counter for the number of button
```

```

int next = 0;
int back = 0;
int buttonPushCounter = 2; // counter for the number of button
presses
int up_buttonState = 0;    // current state of the up button
int up_lastButtonState = 0; // previous state of the up button
//int buzzer = 0;
int down_buttonState = 0;   // current state of the up button
int down_lastButtonState = 0; // previous state of the up button

bool bPress = false;

int dosis;
int lama = 10;
int waktu = 15; // 73 untuk 1 menit
int sisa = 30;
int sisa2 = 0;
int var;
int batas;
int g = 0;
int injek = 10;
float f = 30; //sisa cairan
float a = 30; // dosis cairan keseluruhan
float b = 3100; //jumlah perulangan keseluruhan untuk motor stepper
float c = 0; //
float d = 0;
float e = 0;
float j = 0;
int h = 0;
float BluetoothData;

```



```
pinMode(sw1, INPUT);
pinMode(sw2, INPUT);
pinMode(sw3, INPUT);
pinMode( Up_buttonPin , INPUT_PULLUP);
pinMode( Down_buttonPin , INPUT_PULLUP);
pinMode(out1, OUTPUT);
pinMode(out2, OUTPUT);
pinMode(out3, OUTPUT);
pinMode(out4, OUTPUT);
pinMode(buzzer, OUTPUT);
int i;
BlueSer.begin(9600);
BlueSer.println();
Serial.begin(9600);
rtc.begin();
lcd.init();
lcd.backlight();
digitalWrite(buzzer, HIGH);
delay (200);
digitalWrite(buzzer, LOW);
delay (10);
lcd.print(" INSULIN PUMP ");
lcd.setCursor(0,1);
lcd.print("BY:HABIBURRAHMAN ");
delay(4000);
lcd.clear();
delay(1000);
}
```

```

void loop()
{
if (ok == LOW)
{ menu:
while(1)
{ lcd.print("          ");
  lcd.setCursor(0,0);
  lcd.print("> INJEKSI  ");
  lcd.setCursor(0,1);
  lcd.print(" INSULIN  ");
  delay(300);
  ok = digitalRead(sw1);
  next = digitalRead(sw2);
  back = digitalRead(sw3);
  if (ok == LOW) { delay(lama); goto menu1; }
  if (next == LOW) { delay(lama); goto menu8;}
  if (back == LOW) { } }
menu1:
while(1)
{lcd.setCursor(0,0);
  lcd.print("> MANUAL  ");
  lcd.setCursor(0,1);
  lcd.print(" BOLUS  ");
  delay(300);
  ok = digitalRead(sw1);
  next = digitalRead(sw2);
  back = digitalRead(sw3);
  if (ok == LOW) { delay(lama); goto menu2; }
  if (next == LOW) { delay(lama); goto menu3; }
  if (back == LOW) { delay(lama); goto menu; }}

```

```

menu2:
while(1)
{ lcd.setCursor(0,0);
  lcd.print("Dosis Injek :      ");
  lcd.setCursor(2,1);
  lcd.print("      ");
  lcd.setCursor(6,1);
  lcd.print( buttonPushCounter );
  checkUp();
  checkDown();
  lcd.setCursor(8,1);
  lcd.print(" Unit      ");
  if( bPress){
    bPress = false;
    lcd.setCursor(6,1);
    lcd.print("      ");
    lcd.setCursor(6,1);
    lcd.print(buttonPushCounter ); }
  delay(300);
  ok = digitalRead(sw1);
  next = digitalRead(sw2);
  back = digitalRead(sw3);
  if (ok == LOW) { delay(lama); goto menu7; }
  if (back == LOW) { delay(lama); goto menu1; }}

menu3:
while(1){
  lcd.setCursor(0,0);
  lcd.print(" MANUAL      ");
  lcd.setCursor(0,1);

```

```

while (ok == LOW) {  ok = digitalRead(sw1);
    digitalWrite(out1, HIGH);//1
    digitalWrite(out2, LOW);
    digitalWrite(out3, LOW);
    digitalWrite(out4, HIGH);
    delay(1);
    digitalWrite(out1, LOW);//2
    digitalWrite(out2, HIGH);
    digitalWrite(out3, LOW);
    digitalWrite(out4, HIGH);
    delay(1);
    digitalWrite(out1, LOW);//3
    digitalWrite(out2, HIGH);
    digitalWrite(out3, HIGH);
    digitalWrite(out4, LOW);
    delay(1);
    digitalWrite(out1, HIGH);//4
    digitalWrite(out2, LOW);
    digitalWrite(out3, HIGH);
    digitalWrite(out4, LOW);
    delay(1);
    g++;
    if ( g == 103){ f--;
        e++;
        g=0;
        sisa = f;
    sisa2 = e;// adalah sisa
    lcd.setCursor(8,0);
    lcd.print(sisa2 );}

```

```

menu5:
while(1)
{lcd.setCursor(0,0);
  lcd.print("> AUTO      ");
  lcd.setCursor(0,1);
  lcd.print("      ");
  delay(200);
  ok = digitalRead(sw1);
  next = digitalRead(sw2);
  back = digitalRead(sw3);
  if (ok == LOW) { delay(1ama); goto menu6; }
  if (next == LOW) { }
  if (back == LOW) { delay(1ama); goto menu3; }}
menu6:while(1)
{if (BlueSer.available())
{BluetoothData=BlueSer.read();
Serial.println(BluetoothData);
if(BluetoothData=='1'){
  lcd.print(" ");
  lcd.setCursor(0,0);
  lcd.print("Gula Darah :      ");
  lcd.setCursor(0,1);
  lcd.print("< 60      ");
  lcd.setCursor(4,1);
  lcd.print("mg% = 0 Unit" );
  delay(100); h =0;
  digitalWrite(buzzer, HIGH); delay (200);
  digitalWrite(buzzer, LOW); delay (10);
  batas = 0;}}

```

```

if (BluetoothData== '2'){
  lcd.print(" ");
  lcd.setCursor(0,0);
  lcd.print("Gula Darah :");
  lcd.setCursor(0,1);
  lcd.print("> 59" );
  lcd.setCursor(4,1);
  lcd.print("mg% = 8 Unit" ); h = 8;
  delay(100);
  batas = 826;
  digitalWrite(buzzer, HIGH);
  delay (200);
  digitalWrite(buzzer, LOW);
  delay (10);
}
if(BluetoothData== '3'){
  lcd.print(" ");
  lcd.setCursor(0,0);
  lcd.print("Gula Darah :");
  lcd.setCursor(0,1);
  lcd.print(">199" );
  lcd.setCursor(4,1);
  lcd.print("mg% = 12Unit" ); h = 12;
  delay(100);
  batas = 1240;
  digitalWrite(buzzer, HIGH);
  delay (200);
  digitalWrite(buzzer, LOW);
  delay (10);}

```

```

menu7:
while(1)
{j++;
float injek = buttonPushCounter / a;
c = injek * b;      batas = c;
int i;      float d = f - buttonPushCounter;
var = 0;
injek = j;
    lcd.setCursor(1, 0);
    lcd.print(rtc.getDOWStr(1)); //hari
    lcd.setCursor(4, 0);
    lcd.print(":");
    lcd.setCursor(5, 0);
    lcd.print(rtc.getDateStr()); //tanggal
    lcd.setCursor(04, 1);
    lcd.print(rtc.getTimeStr()); //jam
int k = injek; delay (4000);
    lcd.setCursor(0,0); lcd.print("Proses");
    lcd.setCursor(6,0); lcd.print(" :");
    lcd.setCursor(9,0);
    lcd.print(injek); lcd.print(" ");
    lcd.setCursor(0,1); lcd.print(" Injek :");
    lcd.setCursor(9,1); lcd.print(buttonPushCounter);
    lcd.setCursor(11,1); lcd.print("unit ");
delay(100);
digitalWrite(buzzer, HIGH);
delay (200);
digitalWrite(buzzer, LOW);
delay (10);

```

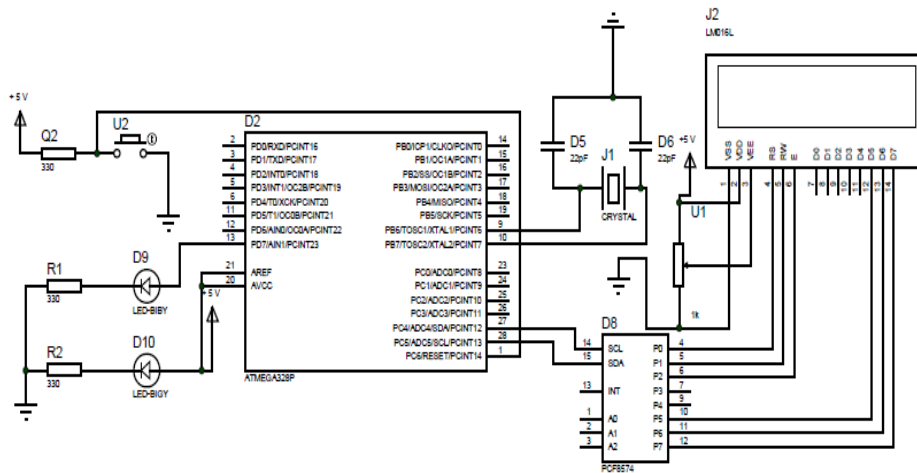
```

while(var < batas){ digitalWrite(out1, HIGH);//1
    digitalWrite(out2, LOW);
    digitalWrite(out3, LOW);
    digitalWrite(out4, HIGH);
    delay(waktu);
    digitalWrite(out1, LOW);//2
    digitalWrite(out2, HIGH);
    digitalWrite(out3, LOW);
    digitalWrite(out4, HIGH);
    delay(waktu);
    digitalWrite(out1, LOW);//3
    digitalWrite(out2, HIGH);
    digitalWrite(out3, HIGH);
    digitalWrite(out4, LOW);
    delay(waktu);
    digitalWrite(out1, HIGH);//4
    digitalWrite(out2, LOW);
    digitalWrite(out3, HIGH);
    digitalWrite(out4, LOW);
    delay(waktu);
    g++;
    if ( g == 103){
        f--; g=0; }
    var++;
    if (var == batas){ sisa = f;
        lcd.clear();
        lcd.setCursor(0,0);
        lcd.print(" injeksi selesai");
        lcd.setCursor(2,1);
        digitalWrite(buzzer, HIGH);
        delay (200);

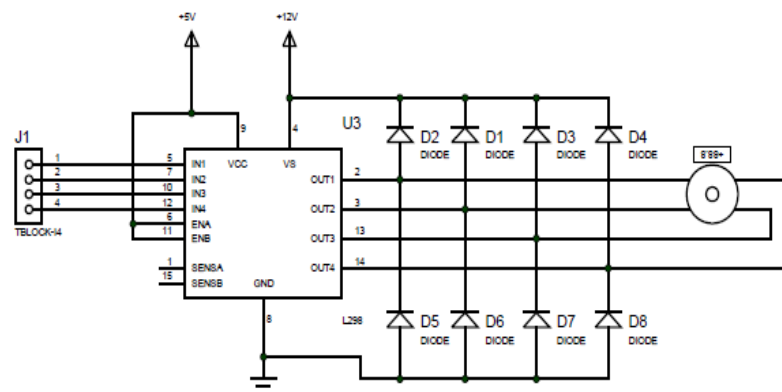
```


3.7.1.2 Pembuatan Program Keseluruhan

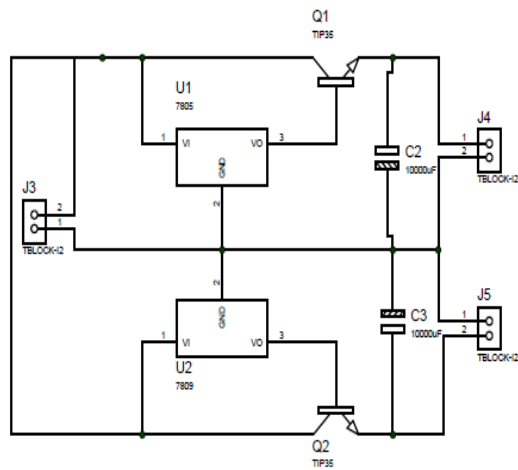
1. Rangkaian *minimum system* dan LCD



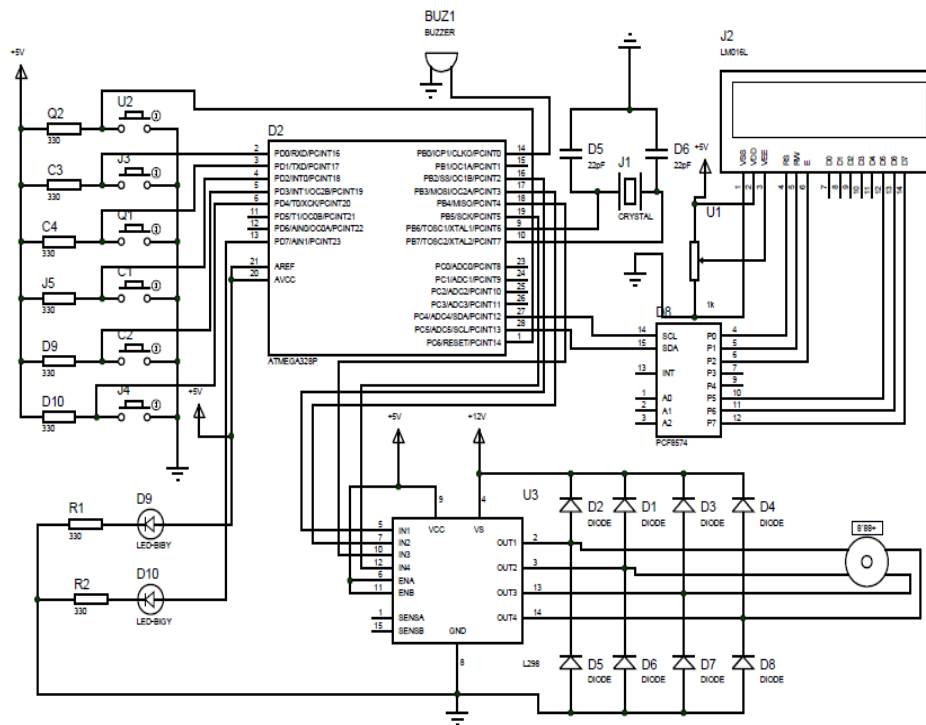
2. rangkaian *Driver Motor* l298



1. Rangkaian Power Supply



2. Rangkaian Keseluruhan



3.7.1.3 Data Sheet Ic L298

