LAMPIRAN 1

Perhitungan Hasil Pengukuran

1. **Hasil Pegujian Volume Cairan Infus pada 1 Menit**

   a. **Analisa perhitungan pada Pengaturan 0,50 ml/min**

      1) **Nilai Rata-rata**

$$\text{rata} - \text{rata}\ (\bar{X}) = \frac{Xn}{n}$$

$$\text{rata} - \text{rata}\ (\bar{X}) = \frac{0{,}51 + 0{,}51 + 0{,}51 + 0{,}51 + 0{,}51 + 0{,}51 + 0{,}51 + 0{,}51 + 0{,}51 + 0{,}51}{10}$$

$$\text{rata} - \text{rata}\ (\bar{X}) = \frac{5{,}1}{10}$$

$$\text{rata} - \text{rata}\ (\bar{X}) = 0{,}51\ \text{ml/min}.$$

      2) **Simpangan**

D= X_s - $\bar{X}$

D= 0,50-0,51

D= -0,01 ml/min

      3) **Persentase Simpangan**

$$\%\ \text{simpangan} = \frac{Xs - \overline{X}}{Xs} \times 100\%$$

$$\%\ \text{simpangan} = \frac{-0{,}01}{0{,}50} \times 100\%$$

$$\%\ \text{simpangan} = -2\%$$

      4) **Standar Deviasi**

$$SD = \sqrt{\frac{\sum\left(X_i - \overline{X}\right)}{(n-1)}}$$

$$\text{SD}= \sqrt{\frac{(0{,}50-0{,}51)^2+(0{,}50-0{,}51)^2+(0{,}50-0{,}51)^2+(0{,}50-0{,}51)^2+(0{,}50-0{,}51)^2+(0{,}50-0{,}51)^2+(0{,}50-0{,}51)^2+(0{,}50-0{,}51)^2+(0{,}50-0{,}51)^2+(0{,}50-0{,}51)^2}{(10-1)}}$$

$$SD=\sqrt{\frac{\frac{0,0001+0,0001+0,0001+0,0001+0,0001+0,0001+0,0001+0,0001+0,0001+0,0001}{9}}}$$

$$SD=\sqrt{\frac{0,001}{9}}=\sqrt{0,00}$$ = 0,00 ml/min.

5) Ketidakpastian (Ua)

Ketidakpastian (Ua) = $\frac{standar\ deviasi}{\sqrt{n}}=\frac{0,00}{\sqrt{10}}$ = 0,00 ml/min

b. Analisa perhitungan pada Pengaturan 0,75 ml/min

1) Nilai Rata-rata

$$\text{rata}-\text{rata}\ (\bar{X})=\frac{Xn}{n}$$

$$\text{rata}-\text{rata}\ (\bar{X})=\frac{0,71+0,71+0,71+0,71+0,71+0,71+0,71+0,71+0,71+0,71}{10}$$

$$\text{rata}-\text{rata}\ (\bar{X})=\frac{7,1}{10}$$

$$\text{rata}-\text{rata}\ (\bar{X})=0,71\ \text{ml/min}.$$

2) Simpangan

D= X_s - $\bar{X}$

D= 0,75-0,71

D= 0,04 ml/min.

3) Persentase Simpangan

$$\%\ \text{simpangan}=\frac{Xs-\overline{X}}{Xs}\times 100\%$$

$$\%\ \text{simpangan}=\frac{0,04}{0,75}\times 100\%$$

$$\%\ \text{simpangan}=5\%$$

4) Standar Deviasi

$$SD = \sqrt{\frac{\sum\left(X_i - \overline{X}\right)}{(n-1)}}$$

$$\text{SD}= \sqrt{\frac{\begin{matrix}(0{,}75-0{,}71)^2+(0{,}75-0{,}71)^2+(0{,}75-0{,}71)^2+(0{,}75-0{,}71)^2+\\(0{,}75-0{,}71)^2+(0{,}75-0{,}71)^2+(0{,}75-0{,}71)^2+(0{,}75-0{,}71)^2+\\(0{,}75-0{,}71)^2+(0{,}75-0{,}71)^2+\end{matrix}}{(10-1)}}$$

$$\text{SD}= \sqrt{\frac{0{,}016}{9}} = \sqrt{0{,}00} = 0{,}00 \text{ ml/min.}$$

5) Ketidakpastian (Ua)

$$\text{Ketidakpastian (Ua)} = \frac{standar\ deviasi}{\sqrt{n}} = \frac{0{,}04}{\sqrt{10}} = 0{,}01 \text{ mil/min.}$$

c. Analisa perhitungan pada Pengaturan 1,00 ml/min

1) Nilai Rata-rata

$$\text{rata} - \text{rata } (\bar{X}) = \frac{Xn}{n}$$

$$\text{rata} - \text{rata } (\bar{X}) = \frac{\begin{matrix}0{,}98+0{,}98+0{,}98+0{,}98+0{,}98+\\0{,}98+0{,}98+0{,}98+0{,}98+0{,}98\end{matrix}}{10}$$

$$\text{rata} - \text{rata } (\bar{X}) = \frac{9{,}8}{10}$$

$$\text{rata} - \text{rata } (\bar{X}) = 0{,}98 \text{ ml/min.}$$

2) Simpangan

$D= X_s - \overline{X}$

D= 1,00-0,98

D= 0,02 ml/min.

3) Persentase Simpangan

$$\%\text{ simpangan} = \frac{Xs - \overline{X}}{Xs} \times 100\%$$

$$\% \text{ simpangan} = \frac{0{,}02}{1{,}00} \times 100\%$$

$$\% \text{ simpangan} = 2\%$$

4) Standar Deviasi

$$SD = \sqrt{\frac{\sum\left(X_i - \overline{X}\right)}{(n-1)}}$$

$$\text{SD} = \sqrt{\frac{\begin{matrix}(1{,}00-0{,}98)^2+(1{,}00-0{,}98)^2+(1{,}00-0{,}98)^2+(1{,}00-0{,}98)^2+\\(1{,}00-0{,}98)^2+(1{,}00-0{,}98)^2+(1{,}00-0{,}98)^2+(1{,}00-0{,}98)^2+\\(1{,}00-0{,}98)^2+(1{,}00-0{,}98)^2\end{matrix}}{(10-1)}}$$

$$\text{SD} = \sqrt{\frac{0{,}04}{9}} = \sqrt{0{,}00} = 0{,}00 \text{ ml/min.}$$

5) Ketidakpastian (Ua)

$$\text{Ketidakpastian (Ua)} = \frac{standar\ deviasi}{\sqrt{n}} = \frac{0{,}00}{\sqrt{10}} = 0{,}00 \text{ ml/min.}$$

2. Hasil Pegujian Volume pada Variabel Maksimal Volume 6 ml

a. Analisa Data Pengujian Target Flow pada Variabel 0,50 ml/min

1) Nilai Rata-rata

$$\text{rata} - \text{rata } (\bar{X}) = \frac{Xn}{n}$$

$$\text{rata} - \text{rata } (\bar{X}) = \frac{\begin{matrix}5{,}85+5{,}85+5{,}85+5{,}85+5{,}85+\\5{,}85+5{,}85+5{,}85+5{,}85+5{,}85\end{matrix}}{10}$$

$$\text{rata} - \text{rata } (\bar{X}) = \frac{58{,}5}{10}$$

$$\text{rata} - \text{rata } (\bar{X}) = 5{,}85 \text{ ml.}$$

2) Simpangan

$D = X_s - \overline{X}$

D= 6,00-5,85

D= 0,15 ml/min.

3) Persentase Simpangan

$$\% \text{ simpangan} = \frac{Xs - \dot{\overline{X}}}{Xs} \times 100\%$$

$$\% \text{ simpangan} = \frac{0{,}15}{6{,}00} \times 100\%$$

$$\% \text{ simpangan} = 2\%$$

4) Standar Deviasi

$$SD = \sqrt{\frac{\sum\left(X_i - \overline{X}\right)}{(n-1)}}$$

$$\text{SD} = \sqrt{\frac{\begin{matrix}(6{,}00-5{,}85)^2+(6{,}00-5{,}85)^2+(6{,}00-5{,}85)^2+(6{,}00-5{,}85)^2+\\(6{,}00-5{,}85)^2+(6{,}00-5{,}85)^2+(6{,}00-5{,}85)^2+(6{,}00-5{,}85)^2+\\(6{,}00-5{,}85)^2+(6{,}00-5{,}85)^2\end{matrix}}{(10-1)}}$$

$$\text{SD} = \sqrt{\frac{0{,}22}{9}} = \sqrt{0{,}02} = 0{,}00 \text{ ml/min.}$$

5) Ketidakpastian (Ua)

$$\text{Ketidakpastian (Ua)} = \frac{standar\ deviasi}{\sqrt{n}} = \frac{0{,}00}{\sqrt{10}} = 0{,}00 \text{ ml/min.}$$

b. Analisa Data Pengujian Target Flow pada Variabel 0,75 ml/min

1) Nilai Rata-rata

$$\text{rata} - \text{rata } (\bar{X}) = \frac{Xn}{n}$$

$$\text{rata} - \text{rata } (\bar{X}) = \frac{\begin{matrix}5{,}80 + 5{,}80 + 5{,}80 + 5{,}80 + 5{,}80 +\\5{,}80 + 5{,}80 + 0{,}98 + 0{,}98 + 0{,}98\end{matrix}}{10}$$

$$\text{rata} - \text{rata } (\bar{X}) = \frac{58}{10}$$

$$\text{rata} - \text{rata } (\bar{X}) = 5{,}80 \text{ ml/min.}$$

2) Simpangan

$$D = X_s - \overline{X}$$

D= 6,00-5,80

D= 0,20 ml/min.

3) Persentase Simpangan

$$\% \text{ simpangan} = \frac{Xs - \dot{\overline{X}}}{Xs} \times 100\%$$

$$\% \text{ simpangan} = \frac{0,20}{6,00} \times 100\%$$

$$\% \text{ simpangan} = 3\%$$

4) Standar Deviasi

$$SD = \sqrt{\frac{\sum\left(X_i - \overline{X}\right)}{\left(n-1\right)}}$$

$$\text{SD} = \sqrt{\frac{\begin{matrix}(6,00-5,80)^2+(6,00-5,80)^2+(6,00-5,80)^2+(6,00-5,80)^2+\\(6,00-5,80)^2+(6,00-5,80)^2+(6,00-5,80)^2+(6,00-5,80)^2+\\(6,00-5,80)^2+(6,00-5,80)^2\end{matrix}}{(10-1)}}$$

$$\text{SD} = \sqrt{\frac{0,40}{9}} = \sqrt{0,44} = 0,00 \text{ ml/min.}$$

5) Ketidakpastian (Ua)

$$\text{Ketidakpastian (Ua)} = \frac{standar\ deviasi}{\sqrt{n}} = \frac{0,00}{\sqrt{10}} = 0,00 \text{ ml/min.}$$

c. Analisa Data Pengujian Target Flow pada Variabel 1,00 ml/min

1) Nilai Rata-rata

$$\text{rata} - \text{rata } (\bar{X}) = \frac{Xn}{n}$$

$$\text{rata} - \text{rata } (\bar{X}) = \frac{\begin{matrix}5,81+5,81+5,81+5,81+5,81+\\5,81+5,81+5,81+5,81+5,81\end{matrix}}{10}$$

$$\text{rata} - \text{rata } (\bar{X}) = \frac{58,1}{10}$$

$$\text{rata} - \text{rata } (\bar{X}) = 5,81 \text{ ml/min.}$$

2) Simpangan

D= X_s - $\bar{X}$

D= 6,00-5,81

D= 0,19 ml/min.

3) Persentase Simpangan

$$\% \text{ simpangan} = \frac{Xs - \dot{\bar{X}}}{Xs} \times 100\%$$

$$\% \text{ simpangan} = \frac{0,19}{6,00} \times 100\%$$

$$\% \text{ simpangan} = 3\%$$

4) Standar Deviasi

$$SD = \sqrt{\frac{\sum\left(X_i - \overline{X}\right)}{\left(n-1\right)}}$$

$$SD = \sqrt{\frac{\begin{matrix}(6,00-5,81)^2+(6,00-5,81)^2+(6,00-5,81)^2+(6,00-5,81)^2+\\(6,00-5,81)^2+(6,00-5,81)^2+(6,00-5,81)^2+(6,00-5,81)^2+\\(6,00-5,81)^2+(6,00-5,81)^2\end{matrix}}{(10-1)}}$$

SD= $\sqrt{\frac{0,36}{9}} = \sqrt{0,04}$ = 0,00 ml/min.

5) Ketidakpastian (Ua)

Ketidakpastian (Ua) = $\frac{standar\ deviasi}{\sqrt{n}} = \frac{0,00}{\sqrt{10}}$ = 0,00 ml/min.

LAMPIRAN 2

Proses Pengujian Sensor Gelembung

Gambar pengukuran diameter gelembung udara pada selang infus dengan hasil diameter gelembung 2 milimeter

Gambar pengukuran diameter gelembung udara pada selang infus dengan hasil diameter gelembung 3 milimeter

Gambar pengukuran diameter gelembung udara pada selang infus dengan hasil diameter gelembung 1 milimeter

LAMPIRAN 3

Lising Program Alat

Lising Program Alat

```
#include <mega16.h>
#include <stdio.h>
#include <stdlib.h>
#include <delay.h>
#include <alcd.h>

#define buble PINB.6
#define start PINB.2
#define up    PINB.3
#define down  PINB.4
#define stop  PINB.5

#define buzzer PORTD.4
int data=0,count2,data1;
float count1;
char buf[33];

interrupt [TIM2_OVF] void timer2_ovf_isr(void)
{

}


void menu2()
{
 buzzer=0;
 if(!up)  {data1=data1+1; delay_ms(200);}
 if(!down){data1=data1-1; delay_ms(200);}
 lcd_gotoxy(0,0);
 lcd_putsf("-MAXIMUM VOLUME-");
 lcd_gotoxy(0,1);
 sprintf(buf," %d ml  ", data1);
 lcd_puts(buf);

 if(data1==0){data1=500;}
 if(data1==501){ data1=1; }
}


void error()
 {
 lcd_clear();
 while(1)
  {
   TCCR1B=0x00;
   lcd_gotoxy(0,0);
   lcd_putsf(" ERROR BUBLE!!!");
   buzzer=1;
   delay_ms(500);
   buzzer=0;
   delay_ms(500);
   if(!start)
   {
   break;
```

```
    }
   }
  }

void tetesan()
  {
   lcd_clear();
   TCCR1B=0x06;
   count1=TCNT1;
   lcd_gotoxy(1,0);
   lcd_putsf("-Cairan Keluar-");
   lcd_gotoxy(0,1);
   lcd_putsf("Volume:");
   count1=count1/20.3;

   lcd_gotoxy(7,1);
   ftoa(count1,2,buf);
   lcd_puts(buf);
   lcd_putsf("mL");
  }

void berhenti()
  {
   lcd_clear();
   while(1)
   {
    lcd_gotoxy(0,0);
    lcd_putsf("______STOP______");
    if(!start)
    {
    return;
    }
    TCCR1B=0x00;
    count1=TCNT1;

    lcd_gotoxy(0,1);
    lcd_putsf("Volume:");
    count1=count1/20.3;
    lcd_gotoxy(7,1);
    ftoa(count1,2,buf);
    lcd_puts(buf) ;
    lcd_puts("mL");

   }
  }

void sepuluh()
  {
   lcd_gotoxy(0,1);
   lcd_putsf("*0,50ml/min");

   if(!start)
   {
   lcd_clear();delay_ms(200);
   while(1)
    {
```

```
    menu2();if(!start)
    {
     TCNT1=0;while(1)
     {
      tetesan();
      count2=TCNT1/20.3;
      if(count2>=data1)      {
       lcd_gotoxy(0,0);
       lcd_putsf("-Proses selesai-");
       buzzer=1;
       delay_ms(3000);
       buzzer=0;
       lcd_clear();return ;
      }
      PORTD=0b00000001;
      delay_ms(97);
      if(!stop){berhenti();}
      if(!buble){error();}
      PORTD=0b00000010;
      delay_ms(97);
      if(!stop){ berhenti();}
      if(!buble){error();}
      PORTD=0b00000100;
      delay_ms(97);
      if(!stop){ berhenti();}
      if(!buble){error();}
      PORTD=0b00001000;
      delay_ms(97);
      if(!stop){ berhenti();}
      if(!buble){error();}

      }
    }
  }
 }
}

void mabelas()
 {
  lcd_gotoxy(0,1);
  lcd_putsf("*0,75ml/min");
  if(!start)
  {
    lcd_clear();delay_ms(200);
    while(1)
    {
      menu2();if(!start)
      {
      TCNT1=0;while(1)
        {
         tetesan();
         count2=TCNT1/20.3;
          if(count2>=data1)
      {
       lcd_gotoxy(0,0);
       lcd_putsf("-Proses selesai-");
```

```
       buzzer=1;
       delay_ms(3000);
       buzzer=0;
       lcd_clear();return ;
      }

      PORTD=0b00000001;
      delay_ms(70);
      if(!stop){ berhenti();}
      if(!buble){error();}

      PORTD=0b00000010;
      delay_ms(70);
      if(!stop){ berhenti();}
      if(!buble){error();}

      PORTD=0b00000100;
      delay_ms(70);
      if(!stop){ berhenti();}
      if(!buble){error();}

      PORTD=0b00001000;
      delay_ms(70);
      if(!stop){ berhenti();}
      if(!buble){error();}
     }
    }
   }
  }
 }
void dupuluh()
 {
  lcd_gotoxy(0,1);
  lcd_putsf("*1,00ml/min");

  if(!start)
  {
   lcd_clear();delay_ms(200);
   while(1)
    {
     menu2();if(!start)
     {
      TCNT1=0;while(1)
      {
       while(1)
       {
        tetesan();
        count2=TCNT1/20.3;
        if(count2>=data1)
        {
         lcd_gotoxy(0,0);
         lcd_putsf("-Proses selesai-");
         buzzer=1;
         delay_ms(3000);
         buzzer=0;
         lcd_clear();return ;
```

```
        }

        PORTD=0b00000001;
        delay_ms(51);
        if(!stop){ berhenti();}
        if(!buble){error();}
        PORTD=0b00000010;
        delay_ms(51);
        if(!stop){ berhenti();}
        if(!buble){error();}
        PORTD=0b00000100;
        delay_ms(51);
        if(!stop){ berhenti();}
        if(!buble){error();}
        PORTD=0b00001000;
        delay_ms(51);
        if(!stop){ berhenti();}
        if(!buble){error();}
       }
      }
     }
    }
  }
 }

void menu()
 {
 buzzer=0;
 if(!up)  {data=data+1; delay_ms(500);}
 if(!down){data=data-1; delay_ms(500);}
 if(data==3){data=0;}
 if(data==-1){data=2;}
 switch(data)
  {
   case 0 :sepuluh();break;
   case 1 :mabelas();break;
   case 2 :dupuluh();break;
   }
 }
void main(void)
{

PORTA=0x00;
DDRA=0x00;

PORTB=0xFF;
DDRB=0x00;

PORTC=0x00;
DDRC=0x00;

PORTD=0x00;
DDRD=0xFF;

TCCR0=0x06;
TCNT0=0x00;
```

```
OCR0=0x00;

TCCR1A=0x00;
TCCR1B=0x06;
TCNT1H=0x00;
TCNT1L=0x00;
ICR1H=0x00;
ICR1L=0x00;
OCR1AH=0x00;
OCR1AL=0x00;
OCR1BH=0x00;
OCR1BL=0x00;

ASSR=0x00;
TCCR2=0x07;
TCNT2=0x8A;
OCR2=0x00;

MCUCR=0x00;
MCUCSR=0x00;

TIMSK=0x40;

UCSRB=0x00;

ACSR=0x80;
SFIOR=0x00;

ADCSRA=0x00;

SPCR=0x00;

TWCR=0x00;

lcd_init(16);

#asm("sei")
 lcd_gotoxy(4,0);
 lcd_putsf("MONITOR");

 lcd_gotoxy(1,1);
 lcd_putsf("CAIRAN INFUS");

 delay_ms(1000);
 lcd_clear();
while (1)
 {

  lcd_gotoxy(3,0);
  lcd_putsf("-TARGET FLOW-");
  menu();

 }
}
```