LAMPIRAN

1. LISTING PROGRAM

```
#include <mega8.h>
#include <delay.h>
#include <stdlib.h>
#include <stdio.h>
#define trigger PORTC.0
#define echo    PINC.1

#define next PIND.1
#define ok PIND.3
float freq;
eeprom float
freq0,freq1,freq2,freq3,freq4,freq5,freq6,freq7,freq8,freq9,
freq10,freq11,freq12,freq13,freq14;
unsigned int i=0,dur;
char buf[33];
unsigned int jarak,vol,vol2,jaraks,save,jarakz;
int menu,sensor,sensors,detik;

// Alphanumeric LCD functions
#include <alcd.h>

// Timer1 overflow interrupt service routine
interrupt [TIM1_OVF] void timer1_ovf_isr(void)
{TCNT1H=0xD23A >> 8;
TCNT1L=0xD23A& 0xff;
i++;}

#define ADC_VREF_TYPE 0x00

// Read the AD conversion result
unsigned int read_ADC(unsigned char ADC_input)
```

```
{ADMUX=ADC_input | (ADC_VREF_TYPE & 0xff);
// Delay needed for the stabilization of the ADC input
voltage
delay_us(10);
// Start the AD conversion
ADCSRA|=0x40;
// Wait for the AD conversion to complete
while ((ADCSRA & 0x10)==0);
ADCSRA|=0x10;
return ADCW;}

void ukur_jarak(){
jarak=0;
delay_us(100);
trigger=1;  //tout, H=5 us
delay_us(10);
trigger=0;
delay_us(40);
    if (echo==1) {jarak++;}
    delay_us(23);
    }}
// Declare your global variables here




void memori(){
menu=0;
lcd_clear();
 while(1){
 if(menu>16)menu=0;
 if(menu<0)menu=10;
if(next==0){menu++;delay_ms(500);lcd_clear();}
if(ok==0){lcd_clear();delay_ms(500);break;}

if(menu==0){
lcd_gotoxy(0,0);
lcd_putsf("data1");
```

```
lcd_gotoxy(0,1);
ftoa(freq0,2,buf);
lcd_puts(buf);
lcd_putsf("ml/s"); }

if(menu==1){
lcd_gotoxy(0,0);
lcd_putsf("data2");
lcd_gotoxy(0,1);
ftoa(freq1,2,buf);
lcd_puts(buf);
lcd_putsf("ml/s");}

if(menu==2){
lcd_gotoxy(0,0);
lcd_putsf("data3");
lcd_gotoxy(0,1);
ftoa(freq2,2,buf);
lcd_puts(buf);
lcd_putsf("ml/s");}

if(menu==3){
lcd_gotoxy(0,0);
lcd_putsf("data4");
lcd_gotoxy(0,1);
ftoa(freq3,2,buf);
lcd_puts(buf);
lcd_putsf("ml/s");}

if(menu==4){
lcd_gotoxy(0,0);
lcd_putsf("data5");
lcd_gotoxy(0,1);
ftoa(freq4,2,buf);
lcd_puts(buf);
lcd_putsf("ml/s");}

if(menu==5){
```

```
lcd_gotoxy(0,0);
lcd_putsf("data6");
lcd_gotoxy(0,1);
ftoa(freq5,2,buf);
lcd_puts(buf);
lcd_putsf("ml/s");}

if(menu==6){
lcd_gotoxy(0,0);
lcd_putsf("data7");
lcd_gotoxy(0,1);
ftoa(freq6,2,buf);
lcd_puts(buf);
lcd_putsf("ml/s");}

if(menu==7){
lcd_gotoxy(0,0);
lcd_putsf("data8");
lcd_gotoxy(0,1);
ftoa(freq7,2,buf);
lcd_puts(buf);
lcd_putsf("ml/s");}

if(menu==8){
lcd_gotoxy(0,0);
lcd_putsf("data9");
lcd_gotoxy(0,1);
ftoa(freq8,2,buf);
lcd_puts(buf);
lcd_putsf("ml/s");}

if(menu==9){
lcd_gotoxy(0,0);
lcd_putsf("data10");
lcd_gotoxy(0,1);
ftoa(freq9,2,buf);
lcd_puts(buf);
lcd_putsf("ml/s");}
```

```
if(menu==10){
lcd_gotoxy(0,0);
lcd_putsf("data11");
lcd_gotoxy(0,1);
ftoa(freq10,2,buf);
lcd_puts(buf);
lcd_putsf("ml/s");}

if(menu==11){
lcd_gotoxy(0,0);
lcd_putsf("data12");
lcd_gotoxy(0,1);
ftoa(freq11,2,buf);
lcd_puts(buf);
lcd_putsf("ml/s");}

if(menu==12){
lcd_gotoxy(0,0);
lcd_putsf("data13");
lcd_gotoxy(0,1);
ftoa(freq12,2,buf);
lcd_puts(buf);
lcd_putsf("ml/s");}

if(menu==13){
lcd_gotoxy(0,0);
lcd_putsf("data14");
lcd_gotoxy(0,1);
ftoa(freq13,2,buf);
lcd_puts(buf);
lcd_putsf("ml/s");}

if(menu==14){
lcd_gotoxy(0,0);
lcd_putsf("data15");
lcd_gotoxy(0,1);
ftoa(freq14,2,buf);
```

```
lcd_puts(buf);
lcd_putsf("ml/s");}

if(menu==15){
lcd_gotoxy(0,0);
lcd_putsf("volume");
lcd_gotoxy(0,1);
sprintf(buf," volume: %d  ml",vol2);
lcd_puts(buf);}

if(menu==16){
lcd_gotoxy(0,0);
lcd_putsf("Kadar");
lcd_gotoxy(12,1);
sprintf(buf,"%d",sensors);
lcd_puts(buf);
        if(sensors<=950){
        lcd_gotoxy(0,1);
        lcd_putsf("jernih"); }

        if(sensors>=950){
        lcd_gotoxy(0,1);
        lcd_putsf("keruh"); }}}}


void flow(){
      TIMSK=0x04;
      TCCR1B=0x07;
      delay_ms(1000);
      TCCR1B=0x00;
      TIMSK=0x00;
      dur=TCNT1;
      freq = (((((dur + i*65536)/7.5)*16.667)));
      TCNT1=0x0000;
      i=0; }

void run(){
detik=0;
```

```
if(freq>1){
while(1){
ukur_jarak();
flow();
jaraks=jarakz-jarak;
vol=jaraks*16;
if(vol<=0){vol=0;}

lcd_gotoxy(0,0);
sprintf(buf,"%d mL",vol);
lcd_puts(buf);

lcd_gotoxy(14,1);
sprintf(buf,"%d",detik);
lcd_puts(buf);

  if(sensor<=950){
  lcd_gotoxy(9,0);
  lcd_putsf("jernih"); }

  if(sensor>=950){
  lcd_gotoxy(9,0);
  lcd_putsf("keruh"); }

  delay_ms(500);
  detik=detik+1;
  ftoa(freq,2,buf);
  lcd_puts(buf);
  lcd_gotoxy(6,1);
  lcd_putsf("mL/s");


  if(detik==1){freq0=freq;}
  if(detik==2){freq1=freq;}
  if(detik==3){freq2=freq;}
  if(detik==4){freq3=freq;}
  if(detik==5){freq4=freq;}
  if(detik==6){freq5=freq;}
```

```
      if(detik==7){freq6=freq;}
      if(detik==8){freq7=freq;}
      if(detik==9){freq8=freq;}
      if(detik==10){freq9=freq;}
      if(detik==11){freq10=freq;}
      if(detik==12){freq11=freq;}
      if(detik==13){freq12=freq;}
      if(detik==14){freq13=freq;}
      if(detik==15){freq14=freq;}
      if(detik==16){sensors=sensor;}
      if(detik==20){vol2=vol;}
      if(detik>20){lcd_clear();break;}
      delay_ms(500);  }}}


void main(void)
{
// Declare your local variables here

// Input/Output Ports initialization
// Port B initialization
// Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In
Func1=In Func0=In
// State7=T State6=T State5=T State4=T State3=T State2=T
State1=T State0=T
PORTB=0x00;
DDRB=0x00;

// Port C initialization
// Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In
Func0=In
// State6=T State5=T State4=T State3=T State2=T State1=T
State0=T
PORTC=0x02;
DDRC=0x01;

// Port D initialization
```

```
// Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In
Func1=In Func0=In
// State7=T State6=T State5=T State4=T State3=T State2=T
State1=T State0=T
PORTD=0x0F;
DDRD=0x00;


// Timer/Counter 0 initialization
// Clock source: System Clock
// Clock value: Timer 0 Stopped
TCCR0=0x00;
TCNT0=0x00;

// Timer/Counter 1 initialization
// Clock source: System Clock
// Clock value: Timer1 Stopped
// Mode: Normal top=0xFFFF
// OC1A output: Discon.
// OC1B output: Discon.
// Noise Canceler: Off
// Input Capture on Falling Edge
// Timer1 Overflow Interrupt: On
// Input Capture Interrupt: Off
// Compare A Match Interrupt: Off
// Compare B Match Interrupt: Off
TCCR1A=0x00;
TCCR1B=0x05;
TCNT1H=0xD2;
TCNT1L=0x3A;
ICR1H=0x00;
ICR1L=0x00;
OCR1AH=0x00;
OCR1AL=0x00;
OCR1BH=0x00;
OCR1BL=0x00;

// Timer/Counter 2 initialization
```

```
// Clock source: System Clock
// Clock value: Timer2 Stopped
// Mode: Normal top=0xFF
// OC2 output: Disconnected
ASSR=0x00;
TCCR2=0x00;
TCNT2=0x00;
OCR2=0x00;

// External Interrupt(s) initialization
// INT0: Off
// INT1: Off
MCUCR=0x00;

// Timer(s)/Counter(s) Interrupt(s) initialization
TIMSK=0x04;

// USART initialization
// USART disabled
UCSRB=0x00;

// Analog Comparator initialization
// Analog Comparator: Off
// Analog Comparator Input Capture by Timer/Counter 1: Off
ACSR=0x80;
SFIOR=0x00;

// ADC initialization
// ADC Clock frequency: 1000.000 kHz
// ADC Voltage Reference: AREF pin
ADMUX=ADC_VREF_TYPE & 0xff;
ADCSRA=0x83;

// SPI initialization
// SPI disabled
SPCR=0x00;

// TWI initialization
```

```
// TWI disabled
TWCR=0x00;

// Alphanumeric LCD initialization
// Connections are specified in the
// Project|Configure|C Compiler|Libraries|Alphanumeric LCD
menu:
// RS - PORTB Bit 5
// RD - PORTD Bit 7
// EN - PORTB Bit 4
// D4 - PORTB Bit 3
// D5 - PORTB Bit 2
// D6 - PORTB Bit 1
// D7 - PORTB Bit 0
// Characters/line: 16
lcd_init(16);

// Global enable interrupts
#asm("sei")
freq=0;
 delay_ms(1);
while (1)
      {
      ukur_jarak();flow();
      sensor=read_ADC(2);
      lcd_clear();
      lcd_gotoxy(0,0);
      lcd_putsf("UROFLOWMETRI");

      if(freq>1000){ freq=0;}
      if(freq>1){ run();}

    if(next==0){delay_ms(500);memori();}

    lcd_gotoxy(14,0);
    sprintf(buf,"%d ",jarak);
    lcd_puts(buf);
```

```
        lcd_gotoxy(0,1);
        sprintf(buf,"%d ",sensor);
        lcd_puts(buf);
        jarakz=jarak;}}
```

2. HASIL PENGUKURAN DEBIT AIR

Dari hasil uji modul TA dengan alat pembanding pada pengukuran debit aliran air setiap 1 detik sebagai berikut:

1. Percobaan pertama:

   Perhitungan fekuensi *oscilloskop* = $\frac{1}{(0{,}05 \times 4{,}8)}$ = 4,1 Hz

   Simpangan = 4,1 – 3 = 1,1.

2. Percobaan kedua:

   Perhitungan frekuensi *oscilloskop* = $\frac{1}{(0{,}05 \times 4{,}8)}$ = 4,4 Hz

   Simpangan = 4,4 – 4 = 0,4.

3. Percobaan ketiga

   Perhitungan frekuensi *oscilloskop* = $\frac{1}{(0{,}02 \times 8)}$ = 6,25 Hz

   Simpangan = 6,25 – 5 = 1,25.

4. Percobaan keempat

   Perhitungan frekuensi *oscilloskop* = $\frac{1}{(0{,}02 \times 6{,}6)}$ = 7,5 Hz

   Simpangan = 7,5 – 6 = 1,5.

5. Percobaan kelima

   Perhitungan frekuensi *oscilloskop* = $\frac{1}{(0{,}02 \times 6{,}3)}$ = 8,3 Hz

Simpangan = 8,3 – 7 = 1,3.

6. Percobaan keenam

   Perhitungan frekuensi *oscilloskop* = $\frac{1}{(0{,}02 \times 5{,}8)}$ = 8,9 Hz

   Simpangan = 8,9 – 8 = 0,9.

7. Percobaan ketujuh

   Perhitungan frekuensi *oscilloskop* = $\frac{1}{(0{,}02 \times 5{,}2)}$ = 9,6 Hz

   Simpangan = 9,6 – 9 = 0,6.

8. Percobaan kedelapan

   Perhitungan frekuensi *oscilloskop* = $\frac{1}{(0{,}02 \times 4{,}6)}$ = 10,6 Hz

   Simpangan = 10,6 – 10 = 0,6.

9. Percobaan kesembilan

   Perhitungan frekuensi *oscilloskop* = $\frac{1}{(0{,}02 \times 4)}$ = 12,5 Hz

   Simpangan = 12,5 – 12 = 0,5.

10. Percobaan kesepuluh

    Perhitungan frekuensi *oscilloskop* = $\frac{1}{(0{,}02 \times 3{,}8)}$ = 13,1 Hz

    Simpangan = 13,1 – 13 = 0,1.

Jumlah rata-rata data: 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 + 12 + 13 = 77

77 / 10 = 7,7

Jumlah rata- rata pembanding: 4,1 + 4,4 + 6,25 + 7,5 + 8,3 + 8,9 + 9,6 + 10,6 + 12,5 + 13,1 = 85,25

85,25 / 10 = 8,525

Simpangan: 8,525 – 7,7 = 0,825

Erorr: $\frac{0,825}{8,525}$ x 100 = 9,6 %

3. HASIL PENGUKURAN KEJERNIHAN AIR

Dari hasil uji modul TA dengan alat pembanding pada pengukuran kejernihan air dapat disimpulkan perbatasan antara kadar keruh dan jernih air berada pada nilai ADC 950. Apabila nilai ADC berada dibawah 950 maka tampilan LCD menunjukan karakter jernih, akan tetapi jika nilai ADC diatas 950 maka tampilan ADC menunjukan karakter keruh.

4. HASIL PENGUKURAN VOLUME AIR

a. Dari hasil uji modul TA dengan alat pembanding (gelas ukur) pada pengukuran *volume* 100 mL di dapat hasil simpangan dan *error* sebesar:

1. Percobaan pertama

   Simpangan = 94 – 100 = 4.

   Error = $\frac{4}{100}$ x 100 = 4 %

2. Percobaan kedua

   Simpangan = 94 – 100 = 4.

   Error = $\frac{4}{100}$ x 100 = 4 %

3. Percobaan ketiga

   Simpangan = 94 – 100 = 4.

   Error = $\frac{4}{100}$ x 100 = 4 %

4. Percobaan keempat

   Simpangan = 94 – 100 = 4.

Error = $\frac{4}{100}$ x 100 = 4 %

5. Percobaan kelima

   Simpangan = 94 – 100 = 4.

   Error = $\frac{4}{100}$ x 100 = 4 %

6. Percobaan keenam

   Simpangan = 94 – 100 = 4.

   Error = $\frac{4}{100}$ x 100 = 4 %

Jumlah rata-rata data: (96+ 96 + 96 + 96 + 96 + 96) / 6 = 96

Jumlah rata- rata pembanding: (100+ 100 + 100 + 100 + 100 + 100) / 6 = 100

Simpangan: 96 - 200 = 8

Erorr: $\frac{4}{100}$ x 100 = 4 %

b. Dari hasil uji modul TA dengan alat pembanding (gelas ukur) pada pengukuran *volume* 200 mL di dapat hasil simpangan dan *error* sebesar:

   1. Percobaan pertama

      Simpangan = 192 – 200 = 8.

      Error = $\frac{8}{200}$ x 100 = 4 %

   2. Percobaan kedua

      Simpangan = 208 – 200 = 8.

      Error = $\frac{8}{200}$ x 100 = 4 %

   3. Percobaan ketiga

      Simpangan = 192 – 200 = 8.

Error $= \frac{8}{200}$ x 100 = 4 %

4. Percobaan keempat

   Simpangan = 99 – 100 = 1.

   Error $= \frac{24}{200}$ x 100 = 12 %

5. Percobaan kelima

   Simpangan = 192 – 200 = 8.

   Error $= \frac{8}{200}$ x 100 = 4 %

6. Percobaan keenam

   Simpangan = 192 – 200 = 8.

   Error $= \frac{8}{200}$ x 100 = 4 %

Jumlah rata-rata data: (192 + 208 + 192 + 176 + 192 + 192) / 6 = 192

Jumlah rata- rata pembanding: (200+ 200 + 200 + 200 + 200 + 200) / 6 = 200

Simpangan: 192 - 200 = 8

Erorr: $\frac{8}{200}$ x 100 = 4 %

c. Dari hasil uji modul TA dengan alat pembanding (gelas ukur) pada pengukuran *volume* 300 mL di dapat hasil simpangan dan *error* sebesar:

   1. Percobaan pertama

      Simpangan = 336 – 300 = 36.

      Error $= \frac{36}{300}$ x 100 = 12 %

   2. Percobaan kedua

      Simpangan = 336 – 300 = 36.

Error = $\frac{36}{300}$ x 100 = 12 %

3. Percobaan ketiga

   Simpangan = 288 – 300 = 14.

   Error = $\frac{4}{300}$ x 100 = 4,6 %

4. Percobaan keempat

   Simpangan = 288 – 300 = 14.

   Error = $\frac{4}{300}$ x 100 = 4,6 %

5. Percobaan kelima

   Simpangan = 304 – 300 = 4.

   Error = $\frac{4}{300}$ x 100 = 1,3 %

6. Percobaan keenam

   Simpangan = 304 – 300 = 4.

   Error = $\frac{4}{300}$ x 100 = 1,3 %

Jumlah rata-rata data: (336 + 336 + 288 + 288 + 304 + 304) / 6 = 309,3

Jumlah rata- rata pembanding: (300+ 300 + 300 + 300 + 300 + 300) / 6 = 300

Simpangan: 309,3 - 300 = 9,3

Erorr: $\frac{9,3}{300}$ x 100 = 3,1 %

d. Dari hasil uji modul TA dengan alat pembanding (gelas ukur) pada pengukuran *volume* 400 mL di dapat hasil simpangan dan *error* sebesar:

   1. Percobaan pertama

      Simpangan = 384 – 400 = 16.

Error = $\frac{16}{400}$ x 100 = 4 %

2. Percobaan kedua

   Simpangan = 400 – 400 = 0.

   Error = $\frac{0}{400}$ x 100 = 0 %

3. Percobaan ketiga

   Simpangan = 316 – 400 = 16.

   Error = $\frac{16}{400}$ x 100 = 4 %

4. Percobaan keempat

   Simpangan = 400 – 400 = 0.

   Error = $\frac{0}{400}$ x 100 = 0 %

5. Percobaan kelima

   Simpangan = 400 – 400 = 0.

   Error = $\frac{0}{400}$ x 100 = 0 %

6. Percobaan keenam

   Simpangan = 400 – 400 = 0.

   Error = $\frac{0}{400}$ x 100 = 0 %

Jumlah rata-rata data: (386 + 400 + 416 + 400 + 400 + 400) / 6 = 400,3

Jumlah rata- rata pembanding: (400+ 400 + 400 + 400 + 400 + 400) / 6 = 400

Simpangan: 400,3 - 400 = 0,3

Erorr: $\frac{0,3}{400}$ x 100 = 0,075 %