Sidang Tugas Akhir

PERANCANGAN SISTEM IRIGASI DAN KONTROL NUTRISI OTOMATIS UNTUK BUDIDAYA TANAMAN DENGAN TEKNIK HIDROPONIK

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- LATAR BELAKANG
- DASAR TEORI
- PERANCANGAN SISTEM
- HASIL PENGUJIAN
- KESIMPULAN

LATAR BELAKANG

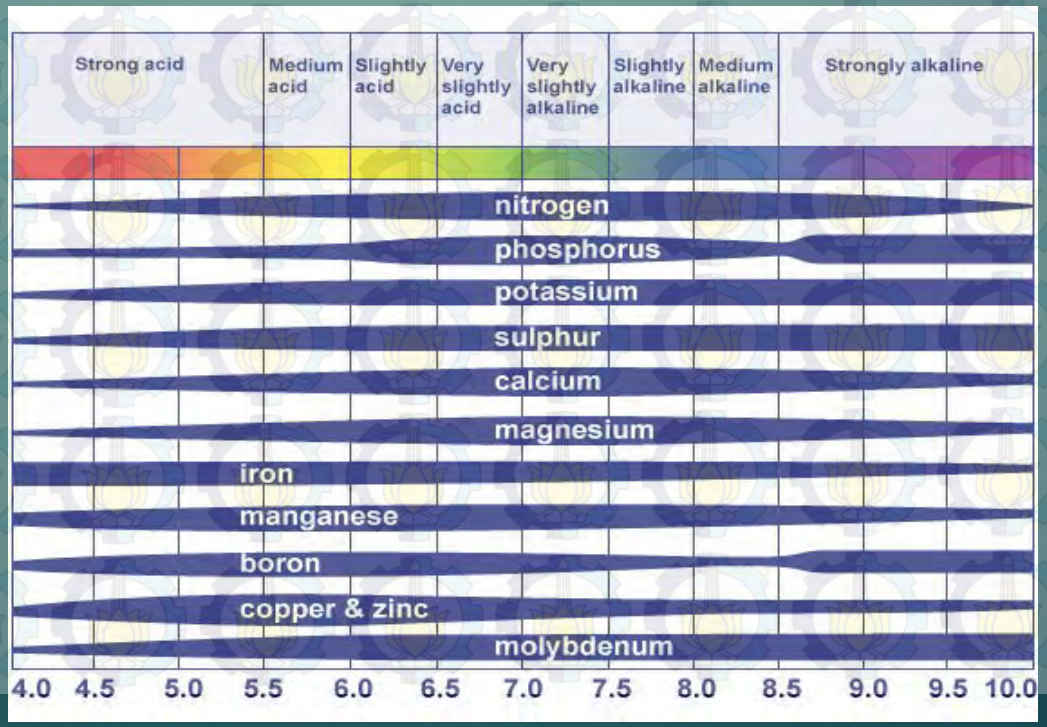
- TEKNOLOGI PERTANIAN
- HIDROPONIK
- INDUSTRIALISASI PERTANIAN

DASAR TEORI

- HIDROPONIK
- PENGUKURAN PH
- PENGUKURAN ELECTRICAL CONDUCTIVITY (EC)
- KONTROL PID

DASAR TEORI | HIDROPONIK

- Pengaruh pH pada tanaman
  - Kemapuan tanaman dalam menyerap nutrisi yang terkandung dalam media tanam
  - Dengan nilai pH yang berbeda, berbeda pula ketersedian nutrisi didalamnya.



DASAR TEORI | HIDROPONIK

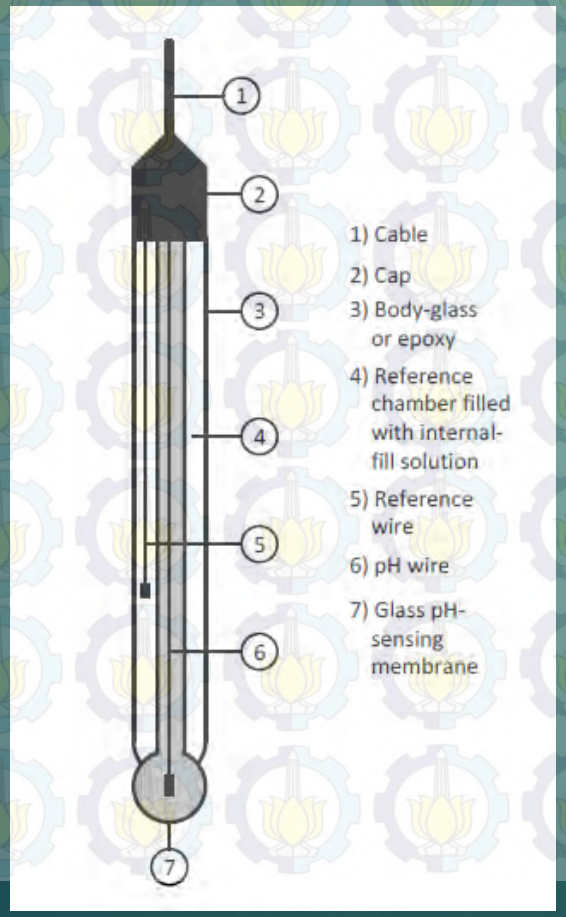
- Pengaruh EC pada tanaman
  - Nilai EC berbanding lurus dengan jumlah garam/nutrisi yang terlarut dalam larutan nutrisi
  - Nilai EC mempengaruhi metabolisme tanaman seperti fotosintesis dan potensi penyerapan ion oleh akar.
  - Hanya mengukur nilai konduktifitas secara umum.

Nama Tanaman	EC
Selada	2.0-3.0
Brokoli	3.0-3.5
Kubis	2.5-3.0
Cabai	1.8-2.2
Kubis Bunga	1.5-2.0
Seledri	2.5-3.0
Mentimun	1.0-2.5
Terung Jepang	2.5-3.5
Bawang Merah	2.0-3.0
Pakcoi	1.5-2.0
Bayam	1.4-1.8
Tomat	2.0-5.0
Kacang-kacangan	2.0-4.0

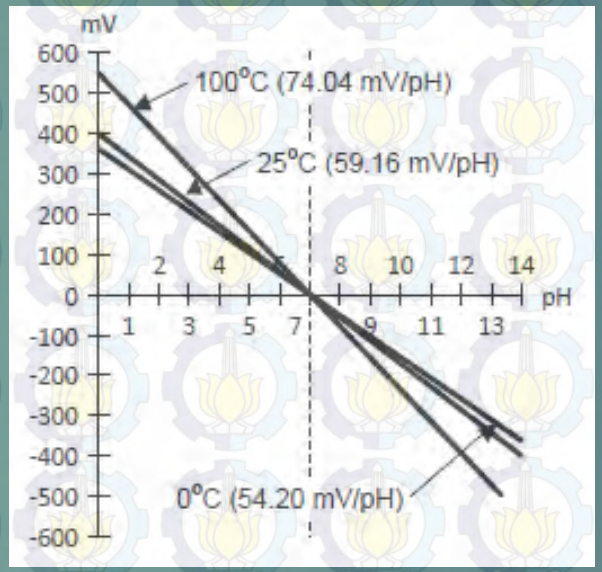
Sumber : Practical Hydroponik & Greenhouse, Issue 37,1997 dalam Untung, 2000.

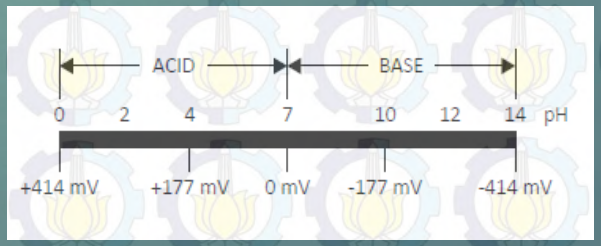
DASAR TEORI | Pengukuran pH

- Sensor pH



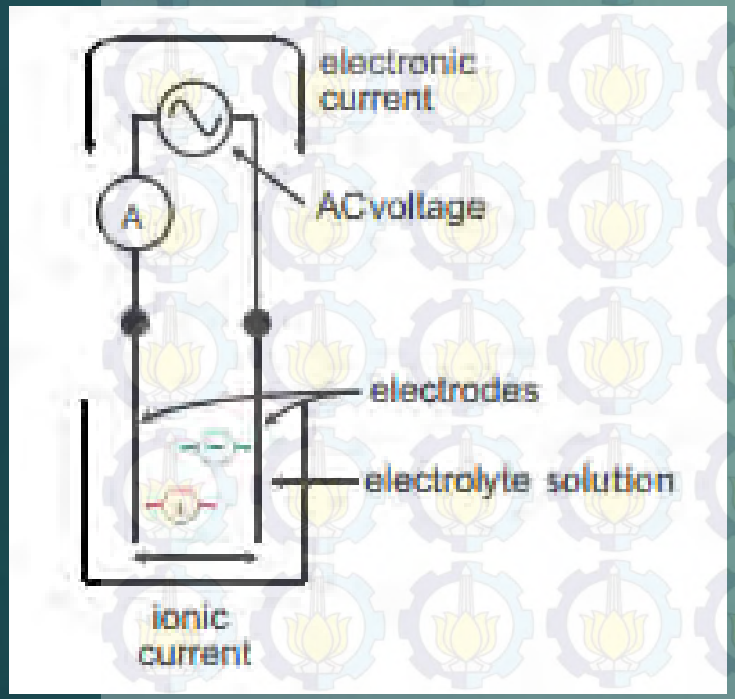
- Karakteristik



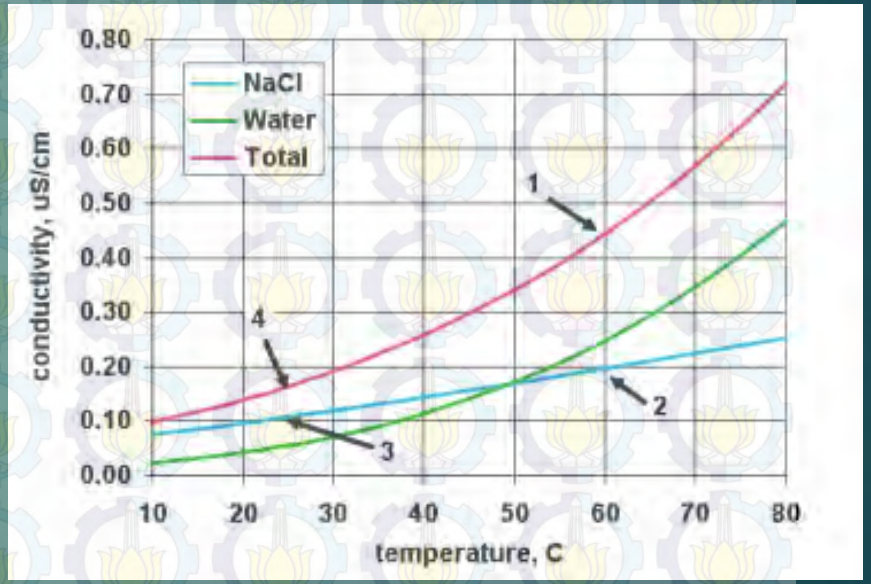


DASAR TEORI | Pengukuran EC

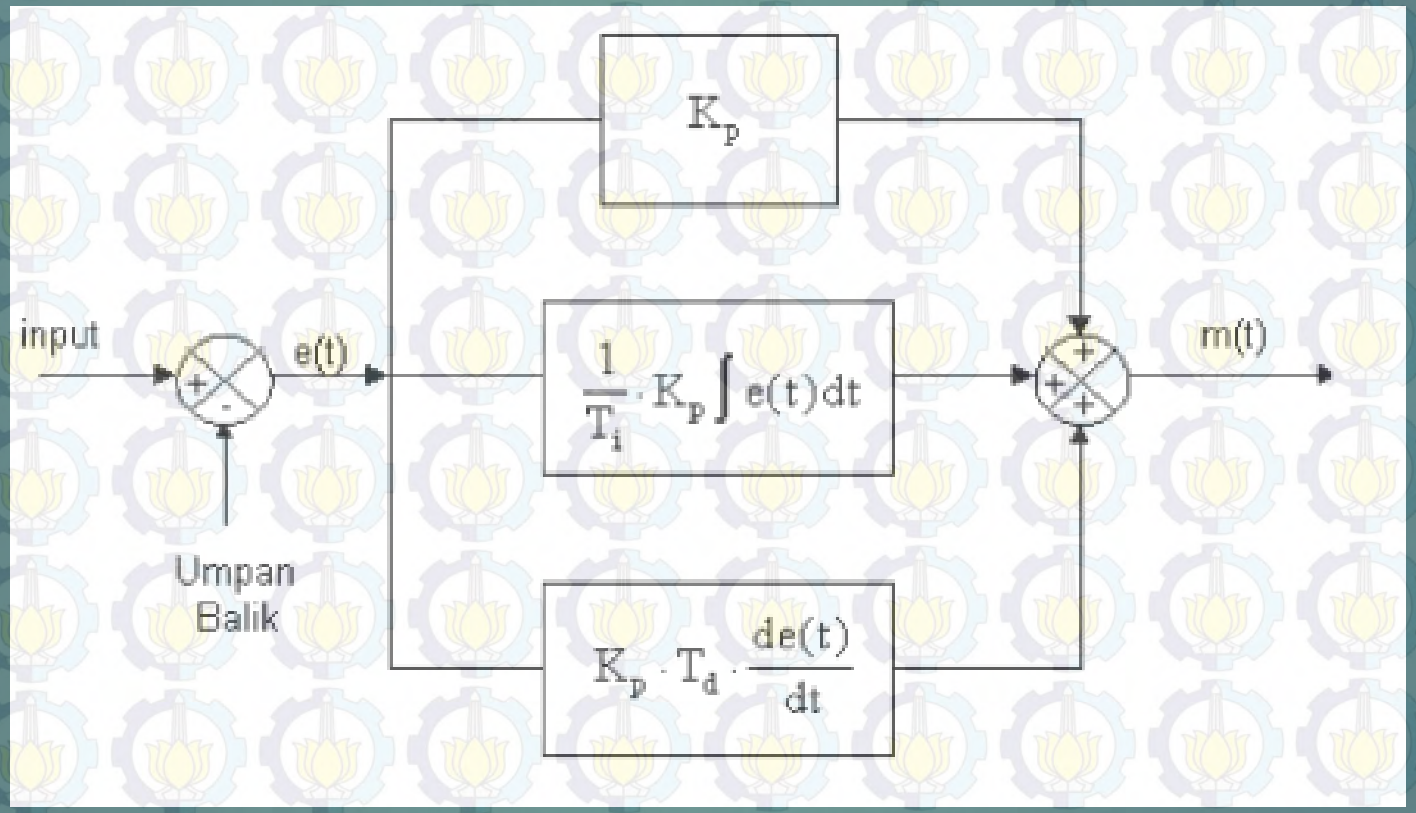
- Sensor EC



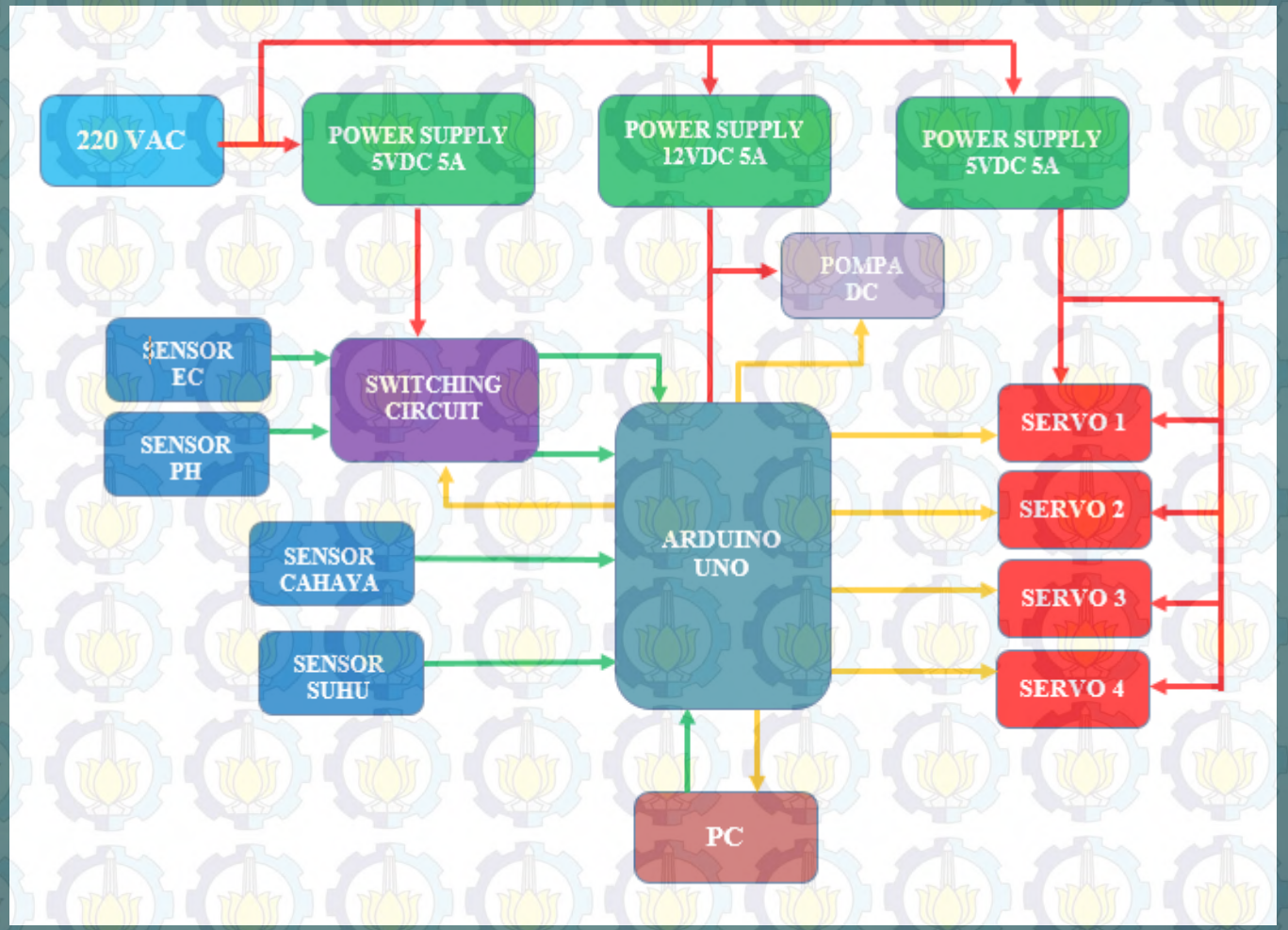
- Karakteristik



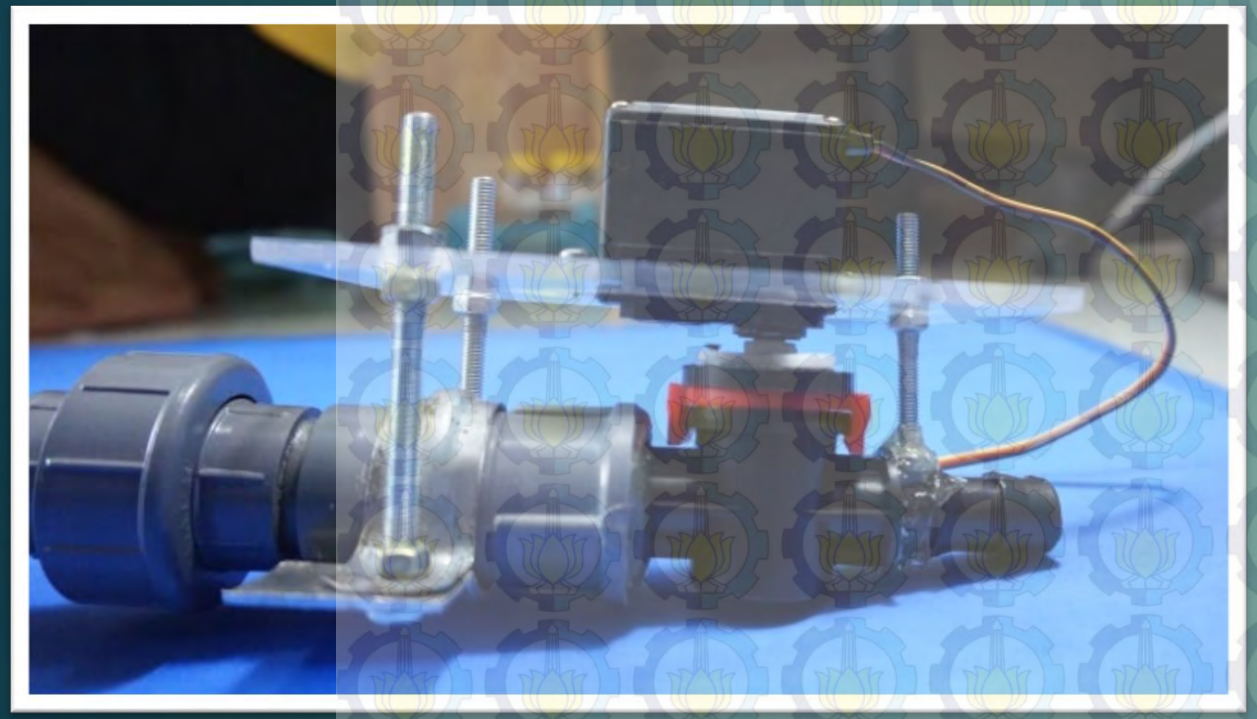
DASAR TEORI | KONTROL PID

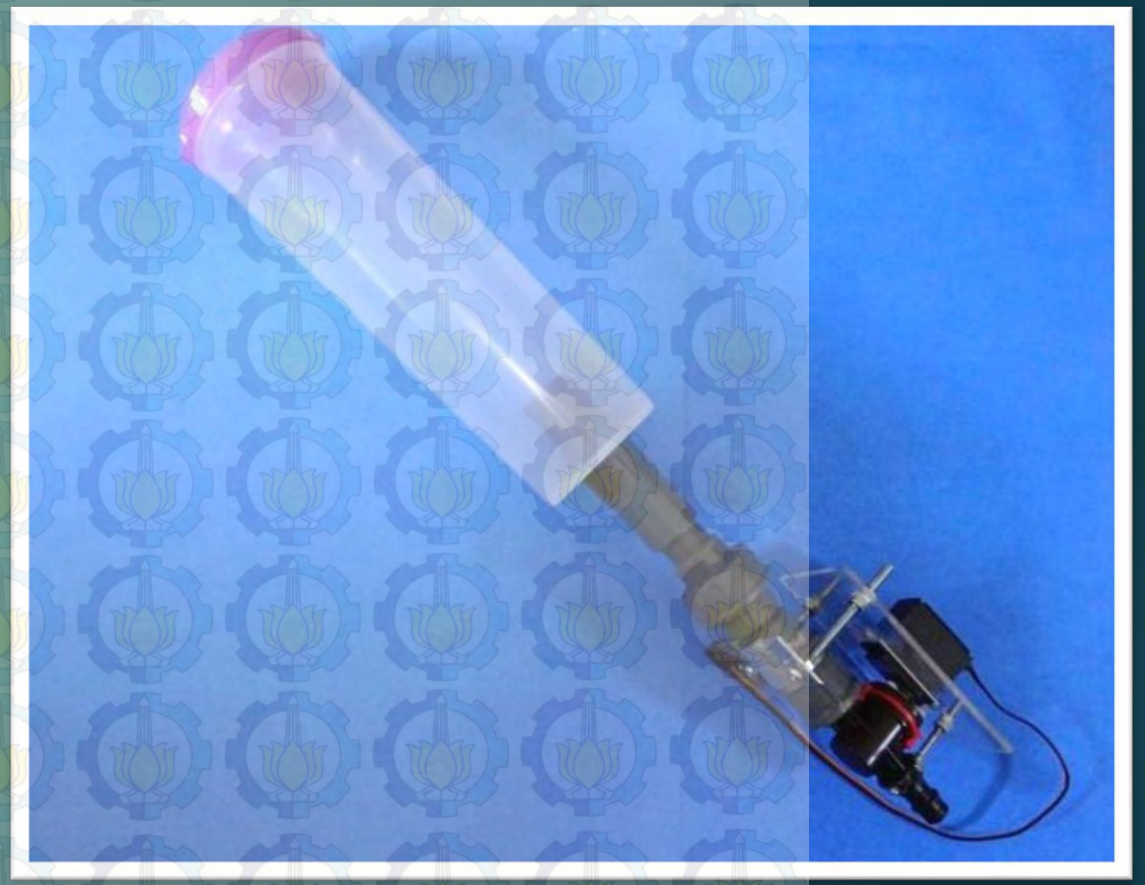


PERANCANGAN SISTEM | DIAGRAM BLOK

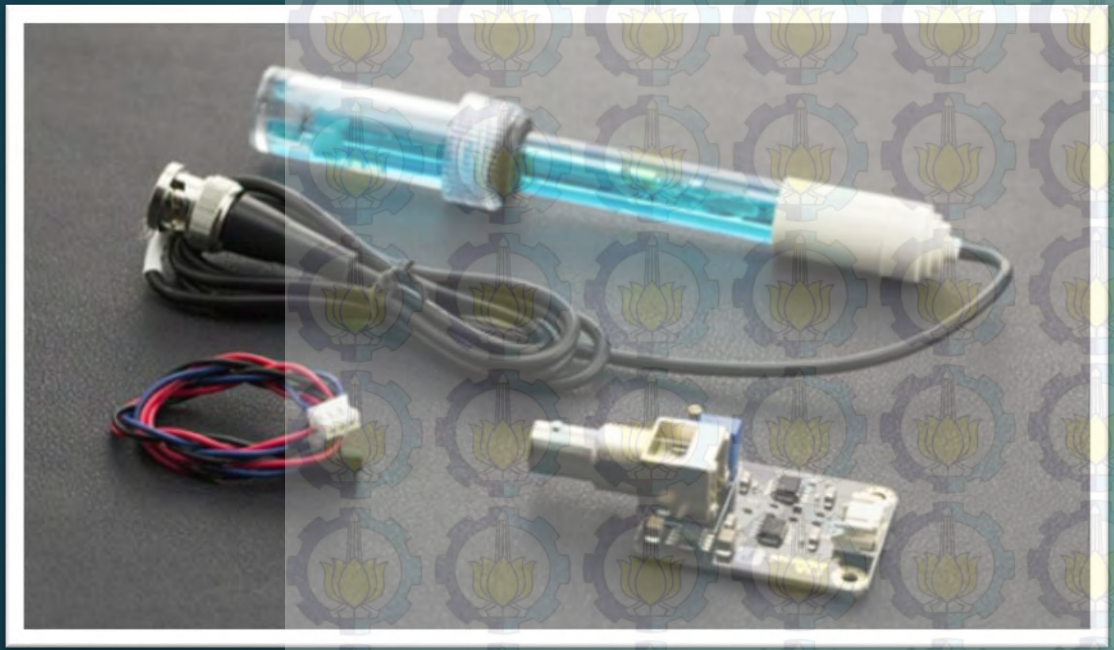


PERANCANGAN SISTEM | HARDWARE





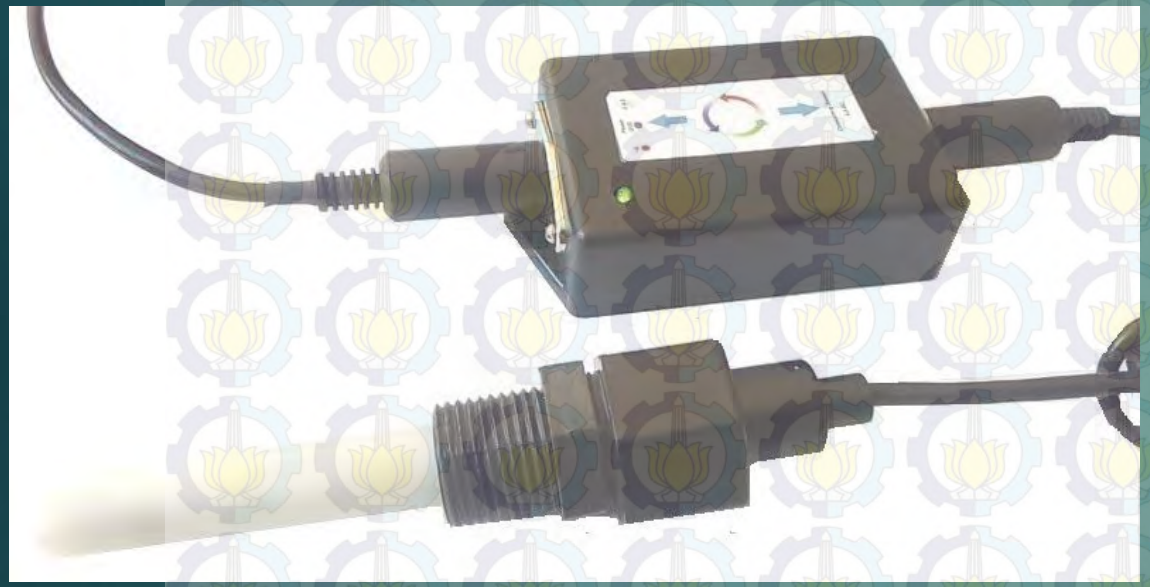
PERANCANGAN SISTEM | SENSOR PH



VOLTAGE （mV）	pH value	VOLTAGE （mV）	pH value
414.12	0.00	-414.12	14.00
354.96	1.00	-354.96	13.00
295.80	2.00	-295.80	12.00
236.64	3.00	-236.64	11.00
177.48	4.00	-177.48	10.00
118.32	5.00	-118.32	9.00
59.16	6.00	-59.16	8.00
0.00	7.00	0.00	7.00

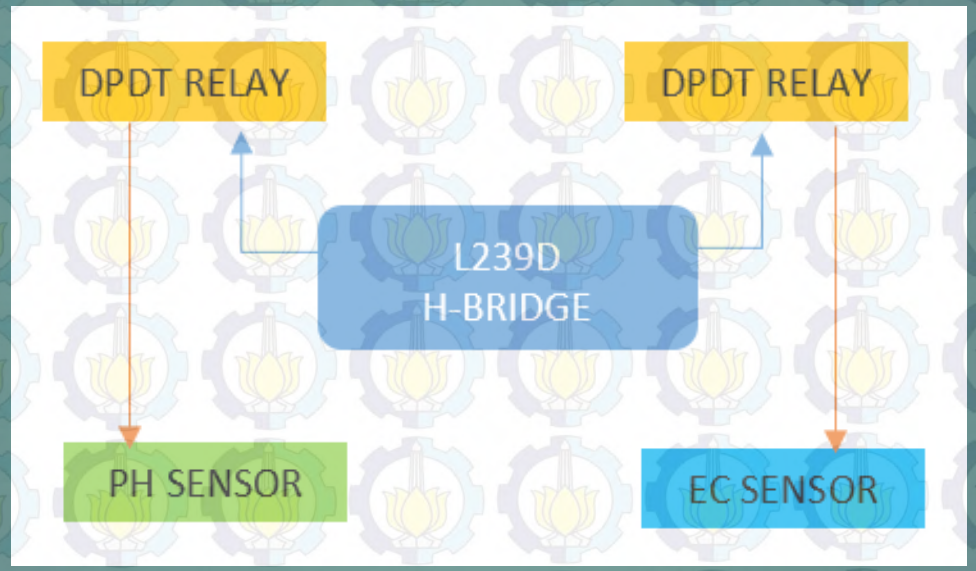
Modul Power : 5.00 V
Measuring Range : 0-14 pH
Measuring Temperature : 0-60 °C
Accuracy : ± 0.1 pH (25°C)
Response Time : ≤ 1 Minute
Probe Type : Lab grade

PERANCANGAN SISTEM | SENSOR EC

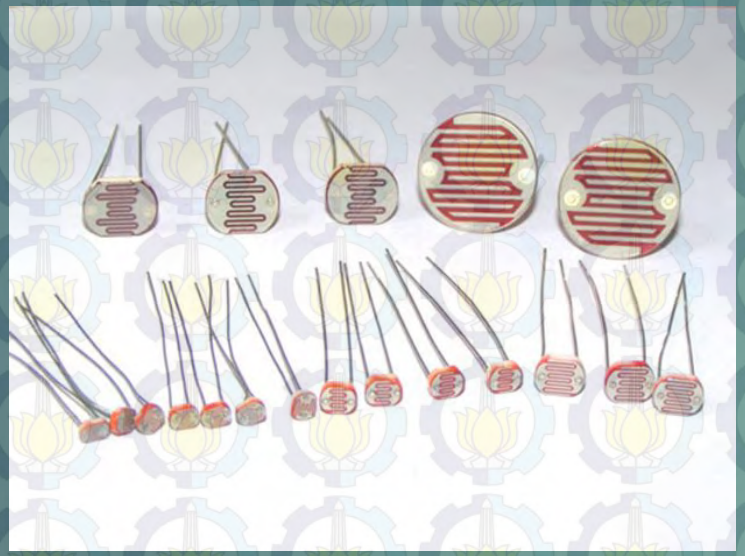


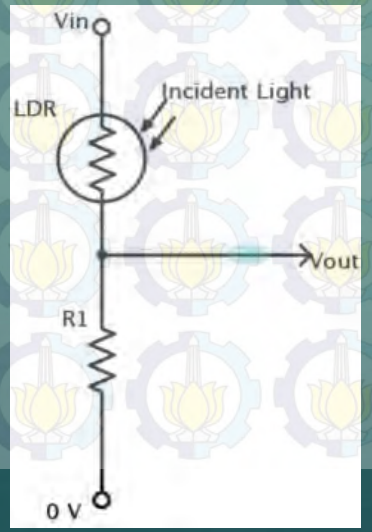
Power : 5 to 15 vdc with power LED
Output : 0-4.5 vdc
Range : 0-5 EC or (0-5000 micro/S)
Accuracy: .2% error
Temperature compensation: Yes
EC electrode: k=1 , submersible/ inline with 1 meter cable. Continous monitoring .Industrial grade.
Size : 3 " x 2" ABS enclosure

PERANCANGAN SISTEM | EC-pH Switching

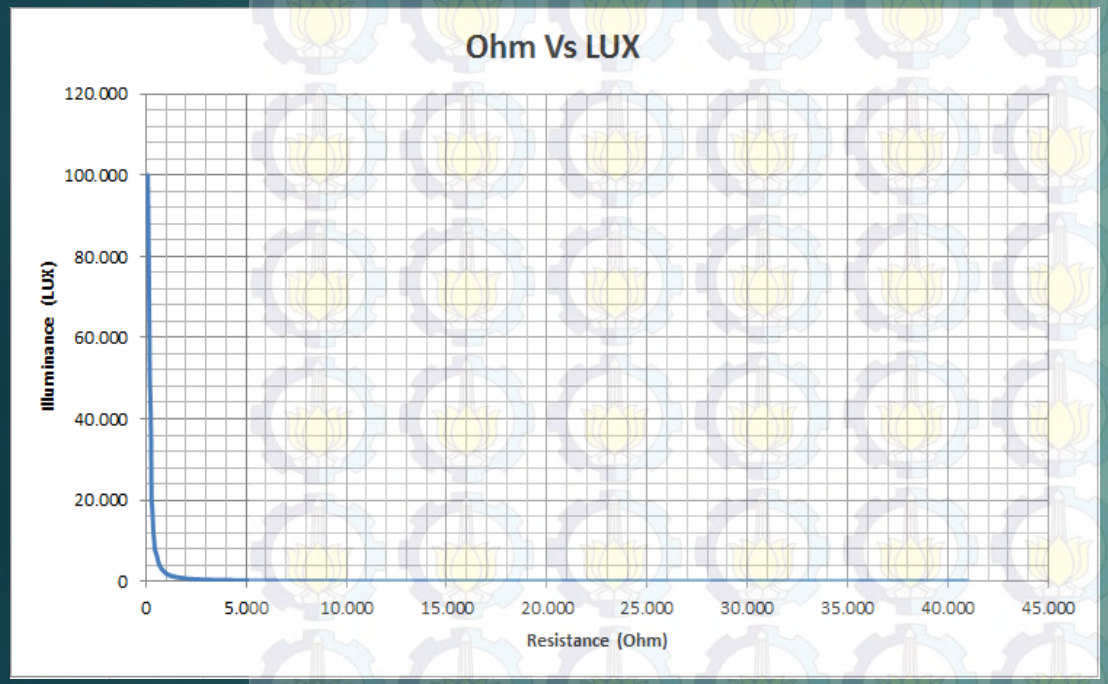


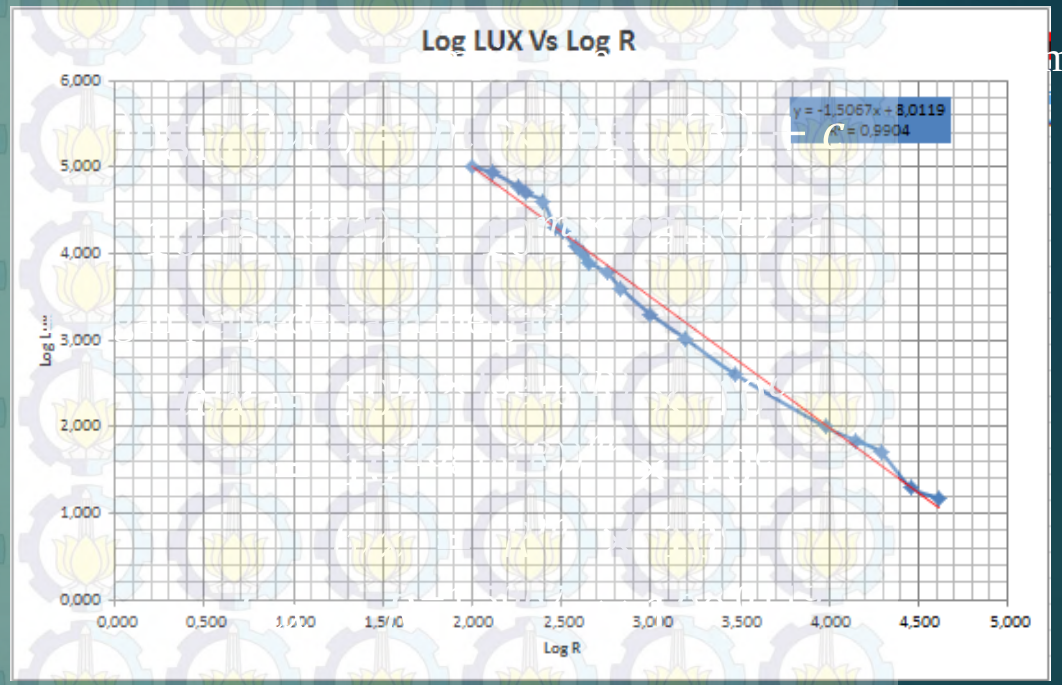
PERANCANGAN SISTEM | SENSOR LDR





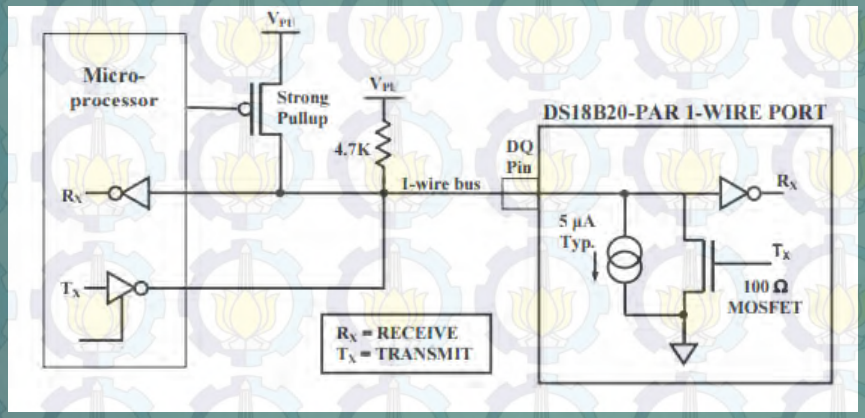
PERANCANGAN SISTEM | SENSOR LDR





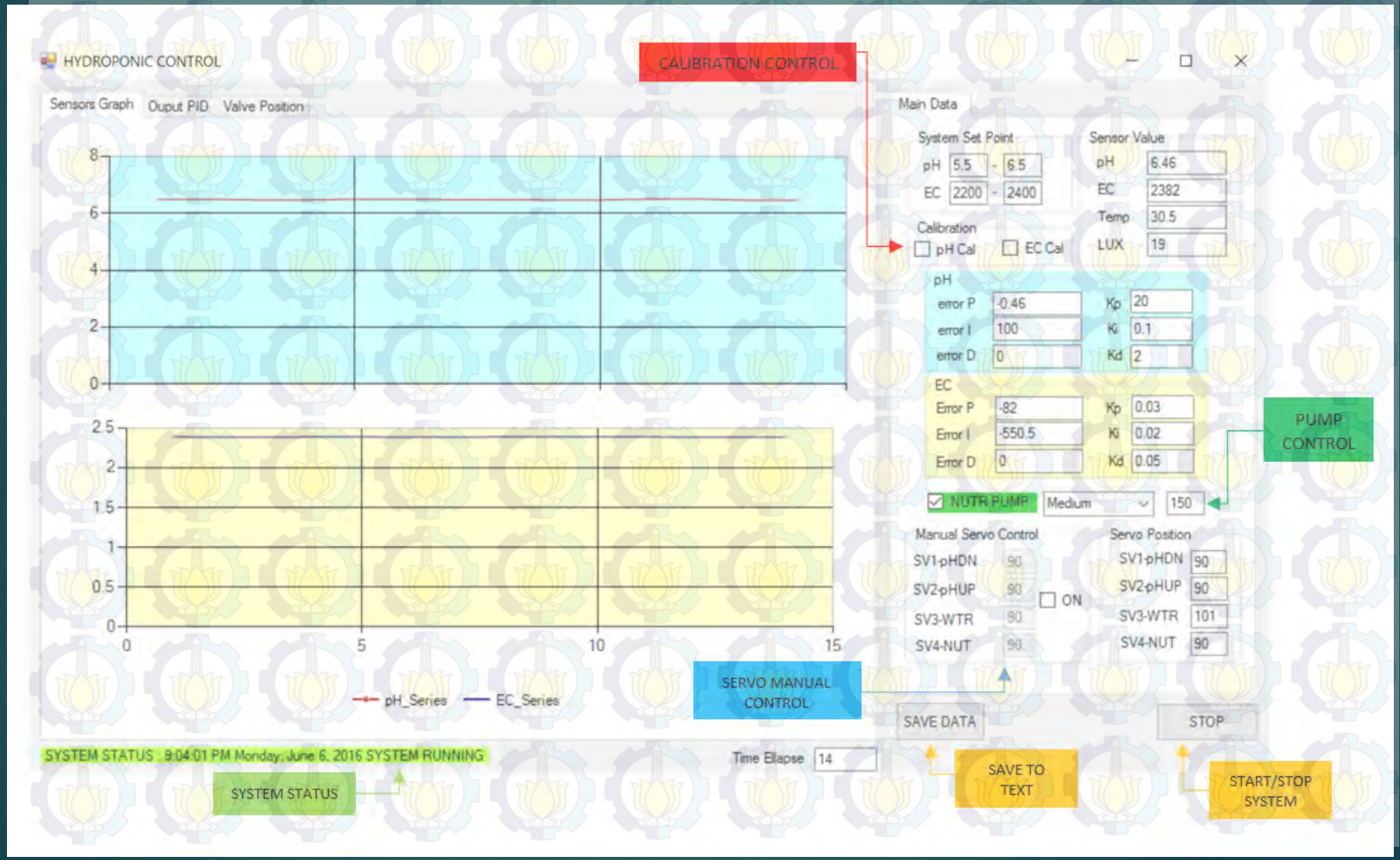
PERANCANGAN SISTEM | SENSOR SUHU

DS18B20



Power : 3.3-5 vdc / Parasite Mode
Output : 12 bit digital
Range : -55 – 125 C
Accuracy: ±0.5 (-10 – 85 C)

PERANCANGAN SISTEM | SOFTWARE HMI



PERANCANGAN SISTEM | SOFTWARE

```
Private Sub Timer2_Tick(sender As Object, e As EventArgs)
    Dim Data() As Byte
    ReDim Data(11)

    If CheckBox1.Checked = True Then
        TextBox24.Enabled = True
        TextBox25.Enabled = True
        TextBox26.Enabled = True
        TextBox27.Enabled = True
        Data(2) = Val(TextBox24.Text)
        Data(4) = Val(TextBox25.Text)
        Data(6) = Val(TextBox26.Text)
        Data(8) = Val(TextBox27.Text)
    Else
        TextBox24.Enabled = False
        TextBox25.Enabled = False
        TextBox26.Enabled = False
        TextBox27.Enabled = False
        Data(2) = servo1pos + 90
        Data(4) = servo2pos + 90
        Data(6) = servo3pos + 90
        Data(8) = servo4pos + 90
    End If
```

```
    If CheckBox2.Checked = True Then
        If ComboBox1.Text = "Slow" Then
            Data(10) = 50
            CheckBox2.BackColor = Color.LimeGreen
        ElseIf ComboBox1.Text = "Medium" Then
            Data(10) = 75
            CheckBox2.BackColor = Color.LimeGreen
        Else
            Data(10) = 125
            CheckBox2.BackColor = Color.LimeGreen
        End If
    Else
        CheckBox2.BackColor = Color.Red
        Data(10) = 0
    End If

    Data(0) = 200
    Data(1) = 201
    Data(3) = 202
    Data(5) = 203
    Data(7) = 204
    Data(9) = 205
    SerialPort1.Write(Data, 0, 11)
End Sub
```

PERANCANGAN SISTEM | SOFTWARE

```
void loop()
{
  if (Serial.available() > 0)
  {
    val = Serial.read();

    if (val == 200)
    {
      readSensors();
    }
    if (val == 201)
    {
      servoValue = 1;
    }
    if (val == 202)
    {
      servoValue = 2;
    }
    if (val == 203)
    {
      servoValue = 3;
    }
    if (val == 204)
    {
      servoValue = 4;
    }
    if (val == 205)
    {
      servoValue = 5;
    }
```

```
if (val < 200)
{
  switch (servoValue)
  {
    case 1:
      servo1Pos = (int) val;
      servo1.write(val);
    break;

    case 2:
      servo2Pos = (int) val;
      servo2.write(val);
    break;

    case 3:
      servo3Pos = (int) val;
      servo3.write(val);
    break;

    case 4:
      servo4Pos = (int) val;
      servo4.write(val);
    break;

    case 5:
      pspeed = val*2;
      analogWrite(Pump,pspeed);
    break;
    default:
    break;
```

```
Serial.print(Temp);
Serial.print (" ");
Serial.print (pH, 2);
Serial.print (" ");
Serial.print(EC);
Serial.print (" ");
Serial.print((int)Lux);
Serial.print(" ")  ;
Serial.print(servo1.read());
Serial.print(" ")  ;
Serial.print(servo2.read());
Serial.print(" ")  ;
Serial.print(servo3.read());
Serial.print(" ")  ;
Serial.print(servo4.read());
Serial.print(" ");
Serial.println(pspeed);
```

PERANCANGAN SISTEM | SOFTWARE

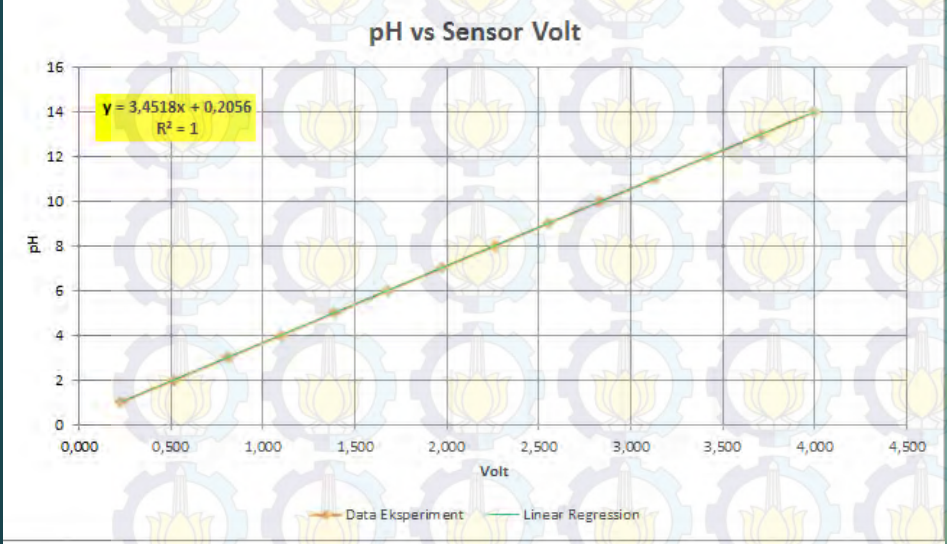
```
Private Sub Timer1_Tick(sender As Object, e As EventArgs)
    Dim data As String
    Dim servo1, servo2, servo3, servo4, pspeed As Double

    If SerialPort1.BytesToRead() > 0 Then
        data = SerialPort1.ReadLine()
        temp = Val(data.Split(" ")(0))
        pH = Val(data.Split(" ")(1))
        EC = Val(data.Split(" ")(2))
        LUX = Val(data.Split(" ")(3))
        servo1 = Val(data.Split(" ")(4))
        servo2 = Val(data.Split(" ")(5))
        servo3 = Val(data.Split(" ")(6))
        servo4 = Val(data.Split(" ")(7))
        pspeed = Val(data.Split(" ")(8))
```

PENGUJIAN | Sensor EC

No.	ec meter	arduino	error
1	498	550	-52
2	2944	2950	-6
3	1136	1215	-79
4	1570	1600	-30
5	2030	2045	-15
6	2630	2620	10

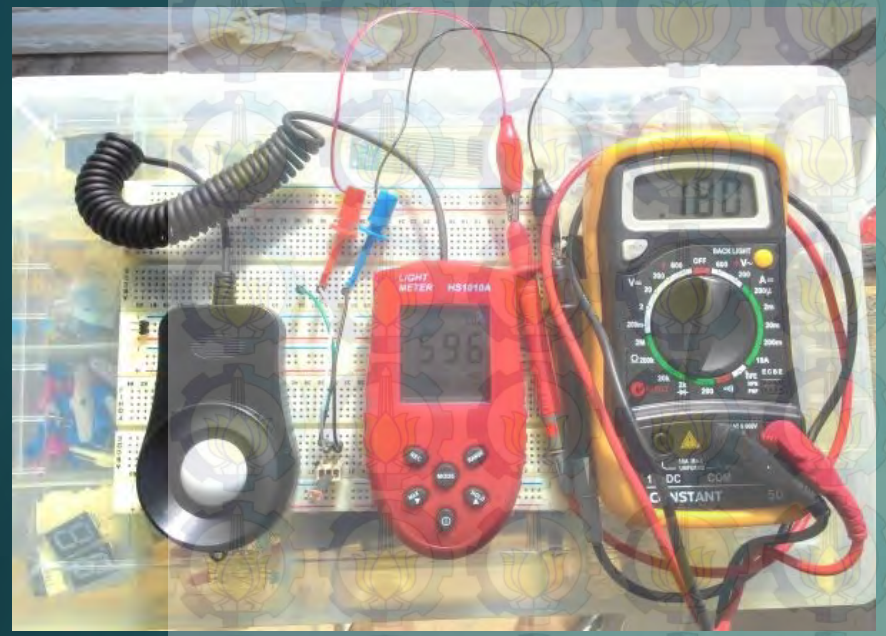
```
//EC Measurment
ECValue = analogRead(EC_PIN);
ECVoltage = ECValue * ref_voltage / max_adc_reading;
EC = map(ECValue, 0, 1024, 0, 5000);
//end of EC Measurment
```

PENGUJIAN | Sensor pH




```
//pH measurement
while (ipH <= pHLength)
{
  pHArray[ipH++] = analogRead(PH_PIN);
  //if(ipH==pHLength)ipH=0;
  pHVoltage = avergearray(pHArray, pHLength) * ref_voltage / max_adc_reading;
  pH = 3.5 * pHVoltage + OffsetPH;
}
ipH = 0;
//end of pH measurment
```

PENGUJIAN | Sensor LDR



LUX meter	LDR	Error
41	124,51	-83,51
152	577	-425
500	2460	-1960
3200	7400	-4200

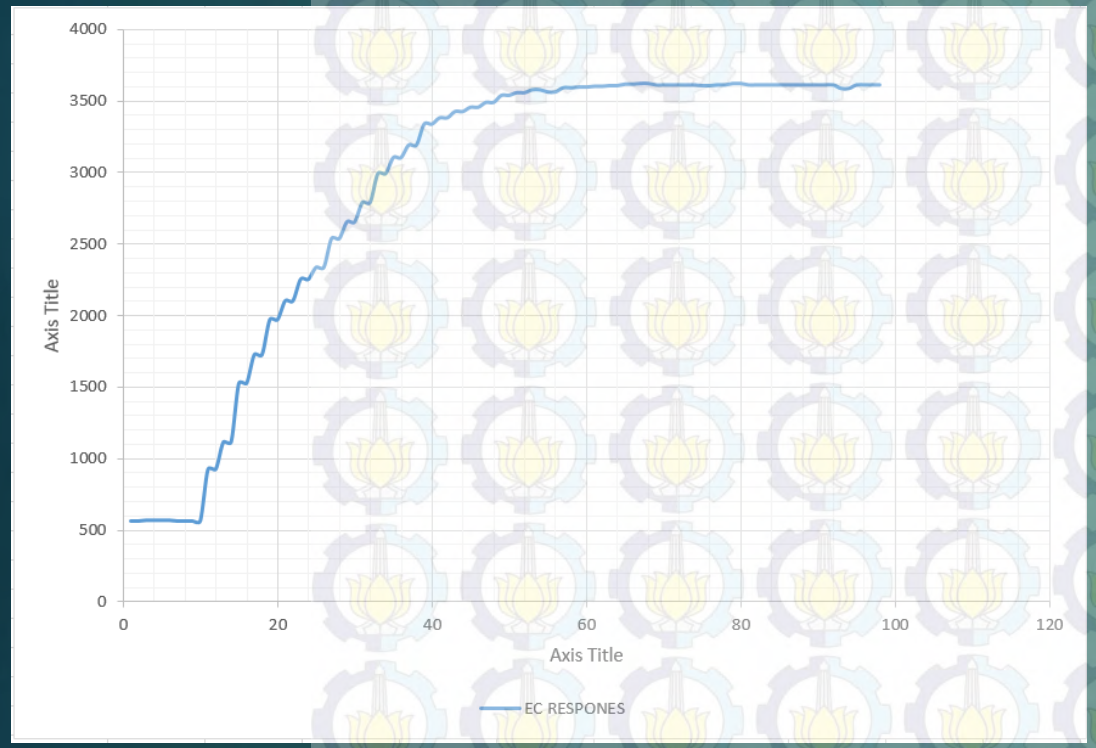
```
//LUX Measurement
iLX = 0; LuxTotal = 0;
while (iLX <= LXLength)
{
  LuxValue = analogRead(LDR_PIN);
  LuxTotal += LuxValue;
  iLX++;
}
LuxAvg = LuxTotal / LXLength;
resistorVoltage = LuxAvg / max_adc_reading * ref_voltage;
ldrVoltage = ref_voltage - resistorVoltage;
ldrResistance = ldrVoltage / resistorVoltage * REF_RESISTANCE;
Lux = (LUX_CALC_SCALAR * pow(ldrResistance, LUX_CALC_EXPONENT));
//end of LUX Measurment
```

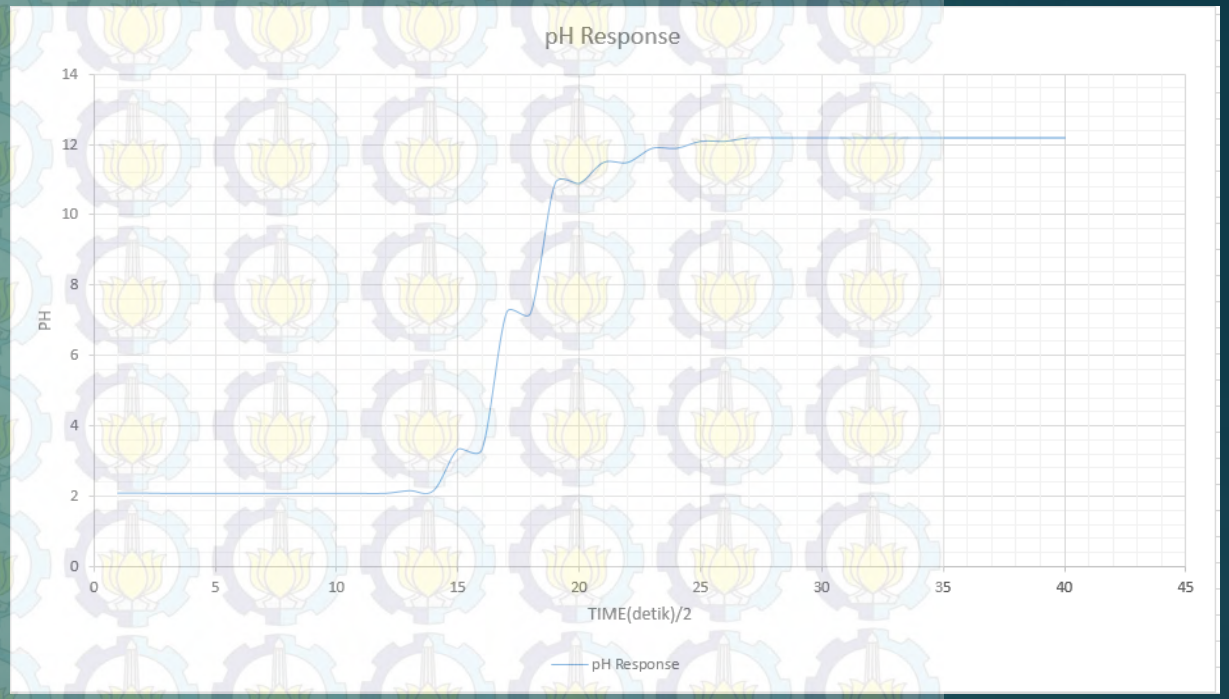
PENGUJIAN | Sensor Suhu

No.	Fluke	DS18B20	error	% error
1	28,5	28,76	0,26	0,91
2	30,87	31,06	0,19	0,62
3	37,3	37,75	0,45	1,21
4	40,1	40,3	0,2	0,50
5	50,3	50,6	0,3	0,60
6	60,4	60,95	0,55	0,91
7	70,1	70,54	0,44	0,63
8	80,4	80,97	0,57	0,71
9	90,2	90,56	0,36	0,40
10	100,3	100,7	0,4	0,40

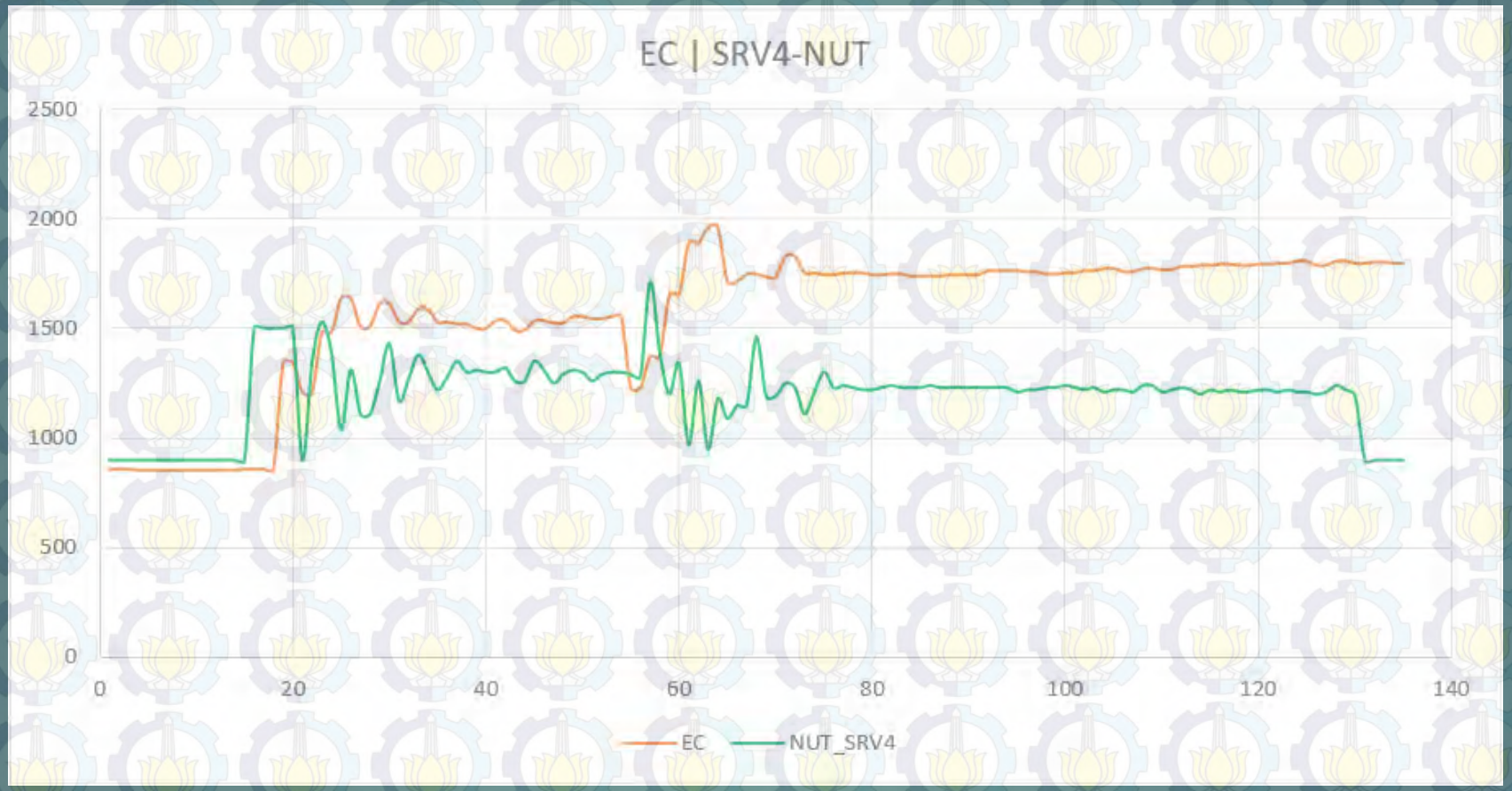
```
//Temperature Measurement
sensorTemp.requestTemperaturesByIndex(0);
Temp = sensorTemp.getTempCByIndex(0);
//end of Temperature Measurment
```

PENGUJIAN | Keran Nutrisi dan pH



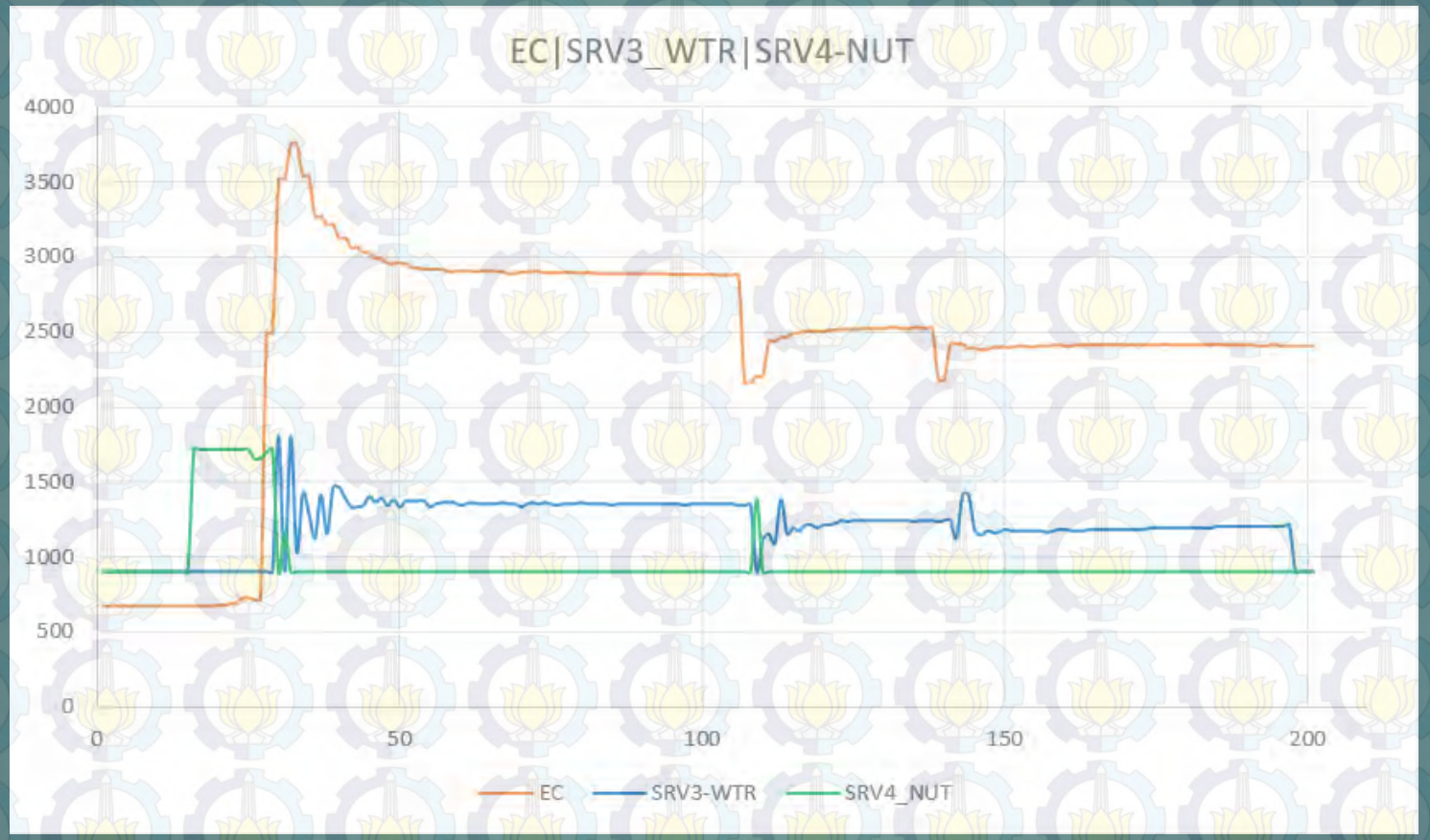


PENGUJIAN | Kontrol EC-1



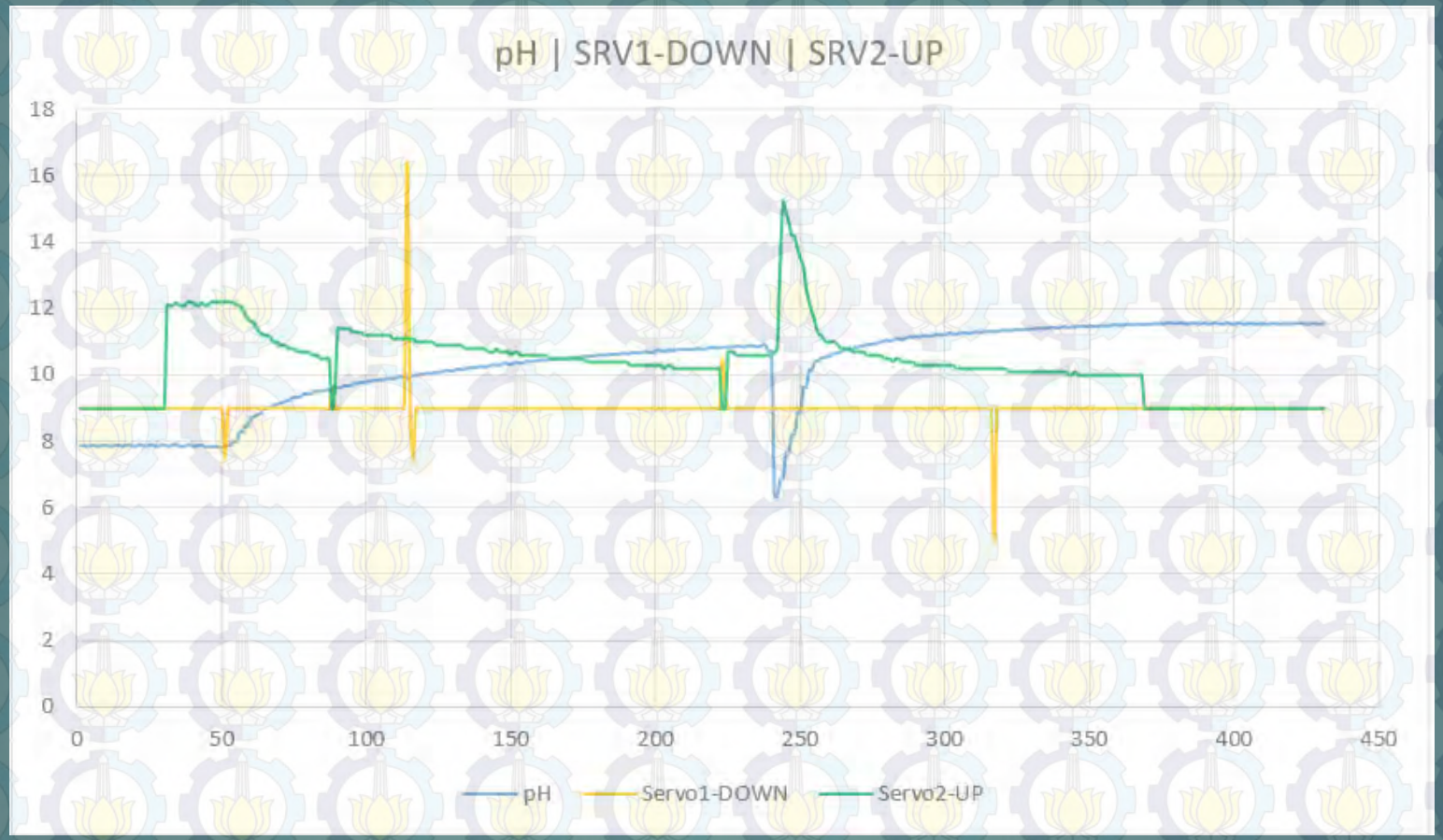
Pengujian diatas dilakukan dengan set point 1500-2000 uS, nilai Kp = 0.03, Ki =0.015, Kd = 0.05

PENGUJIAN | Kontrol EC-2



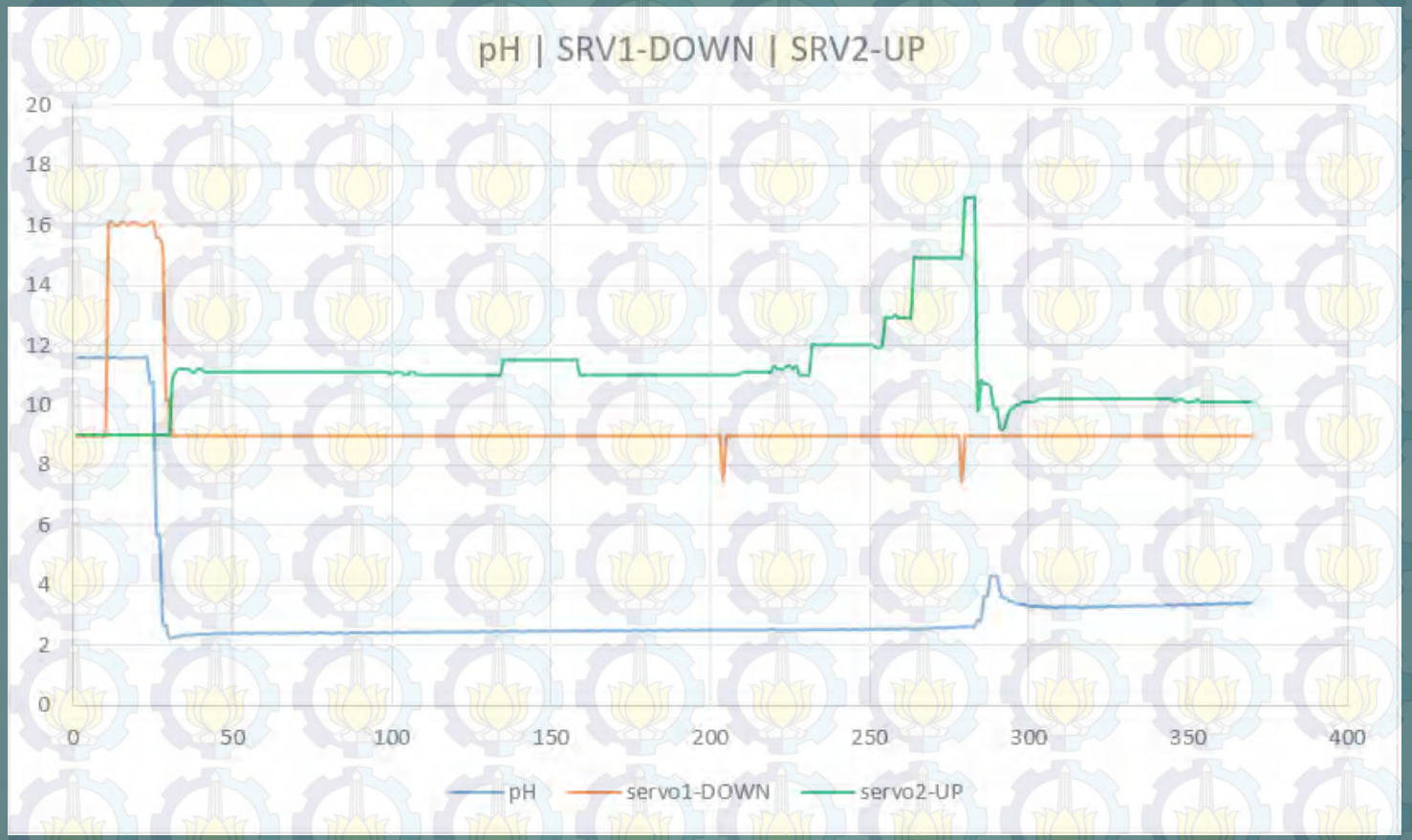
Pengujian diatas dilakukan dengan set point 2300-2500 uS, nilai Kp = 0.03, Ki =0.015, Kd = 0.05

PENGUJIAN | Kontrol pH-1



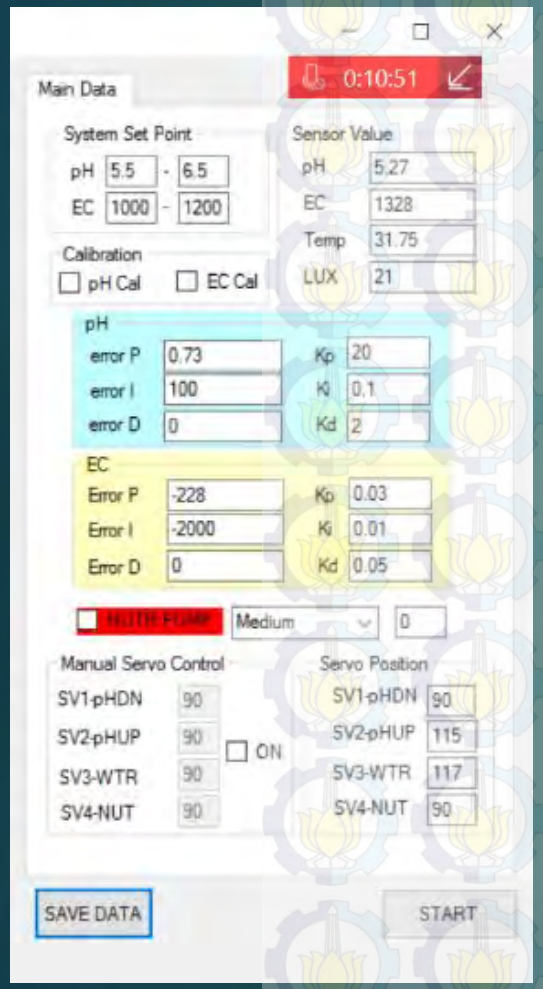
Pengujian diatas dilakukan dengan set point 11-12, nilai Kp = 10, Ki =0.3, Kd = 2

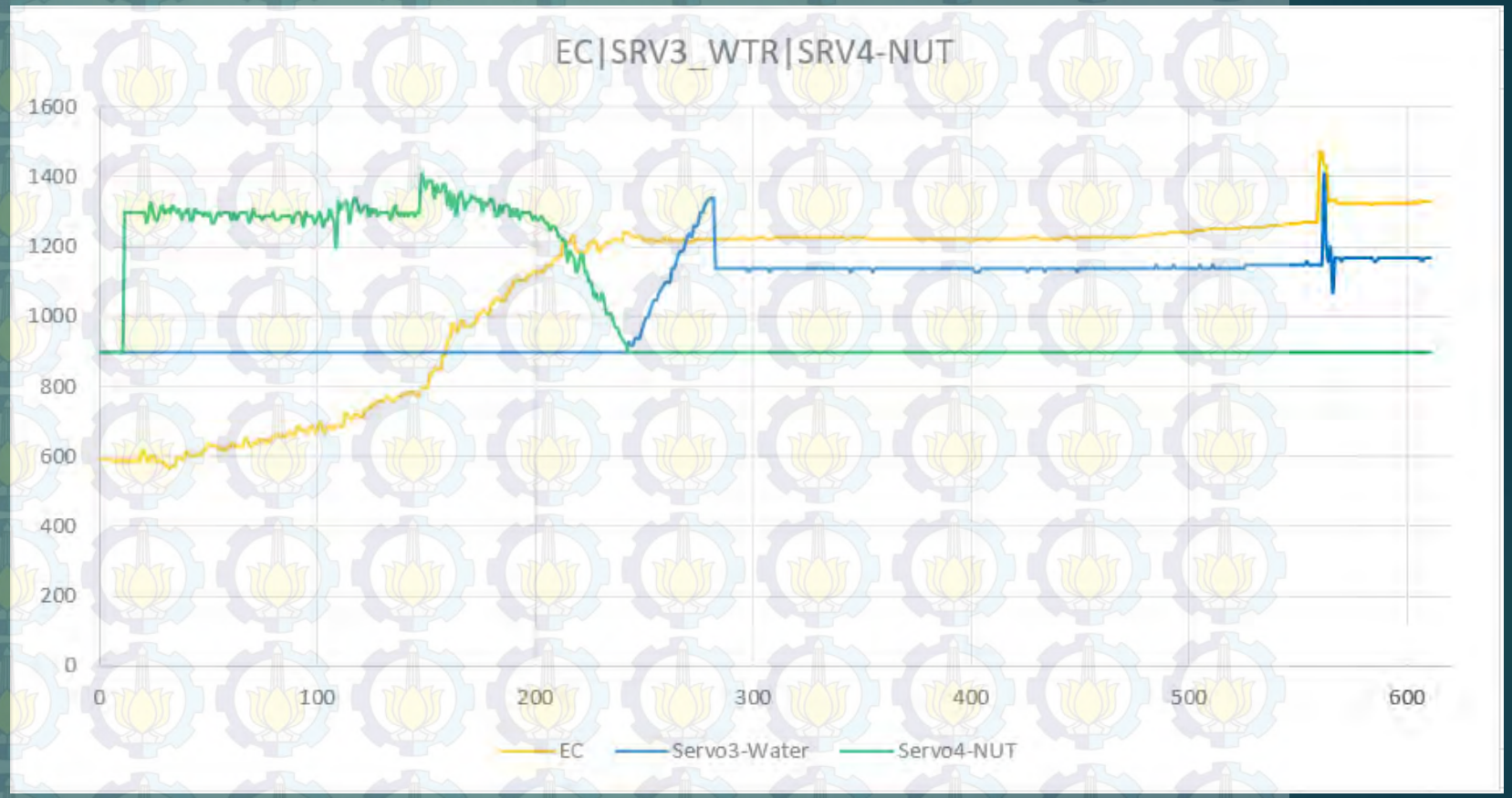
PENGUJIAN | Kontrol pH-2



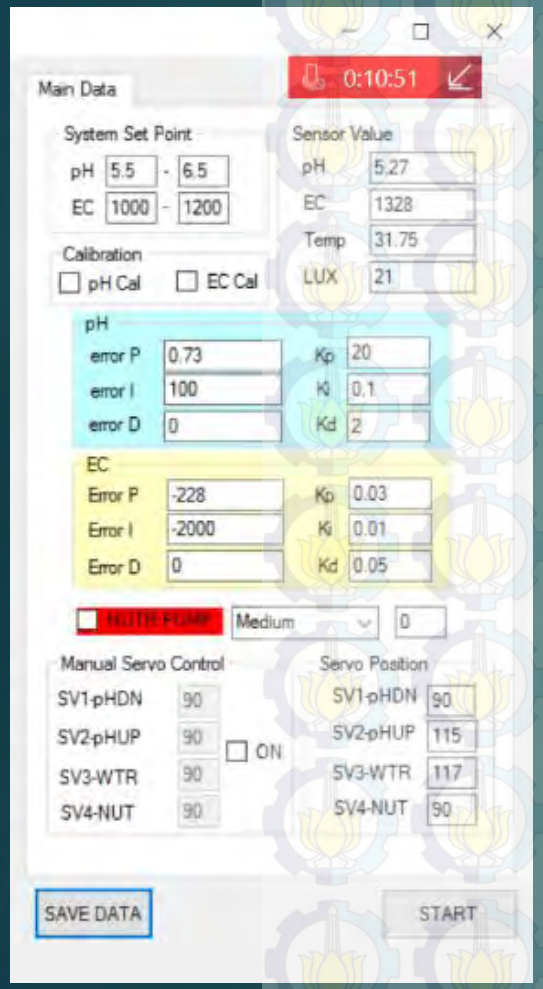
Pengujian diatas dilakukan dengan set point 3-4
nilai Kp = 10, Ki =0.3, Kd = 2

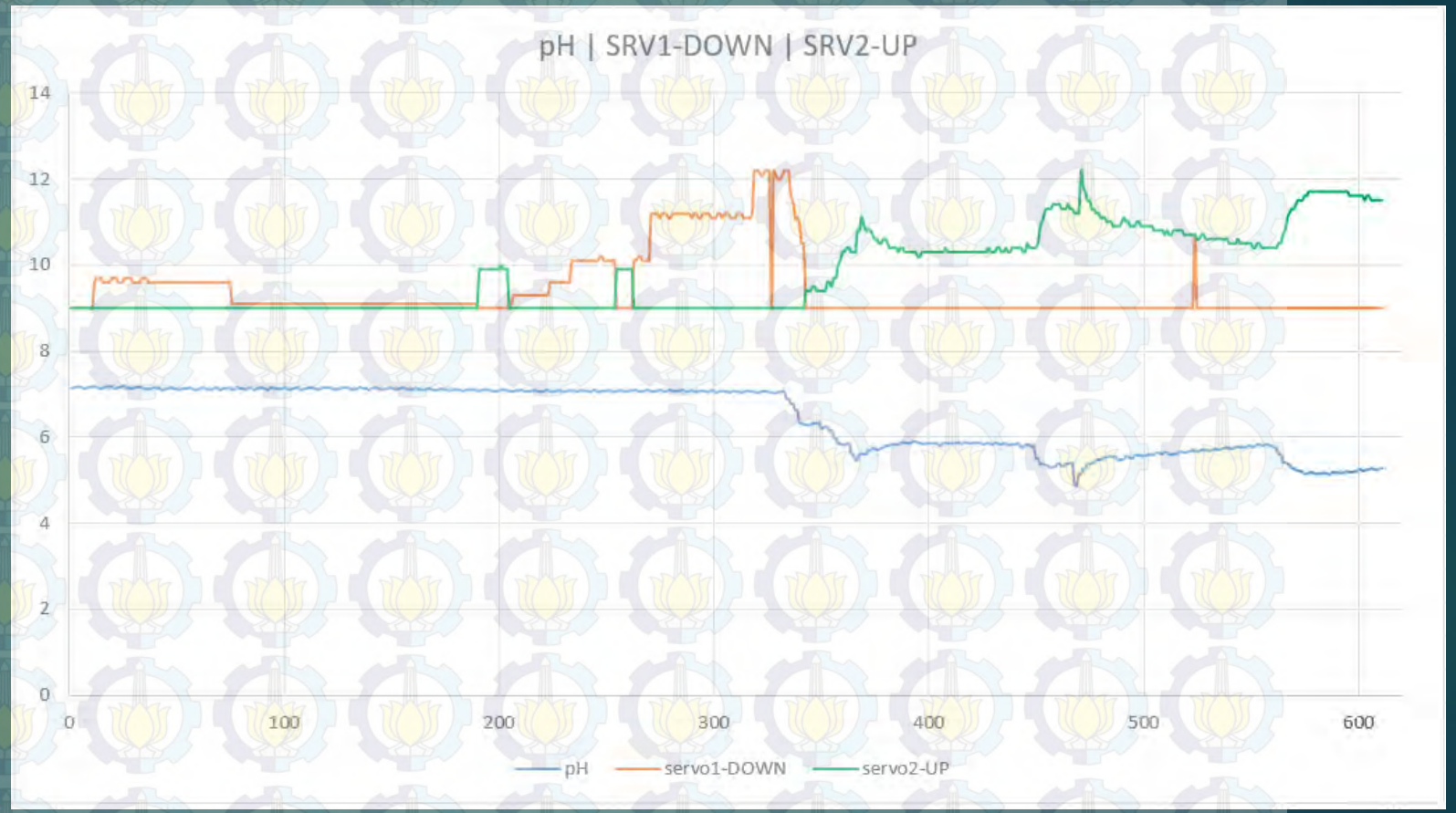
PENGUJIAN | Kontrol pH&EC -1



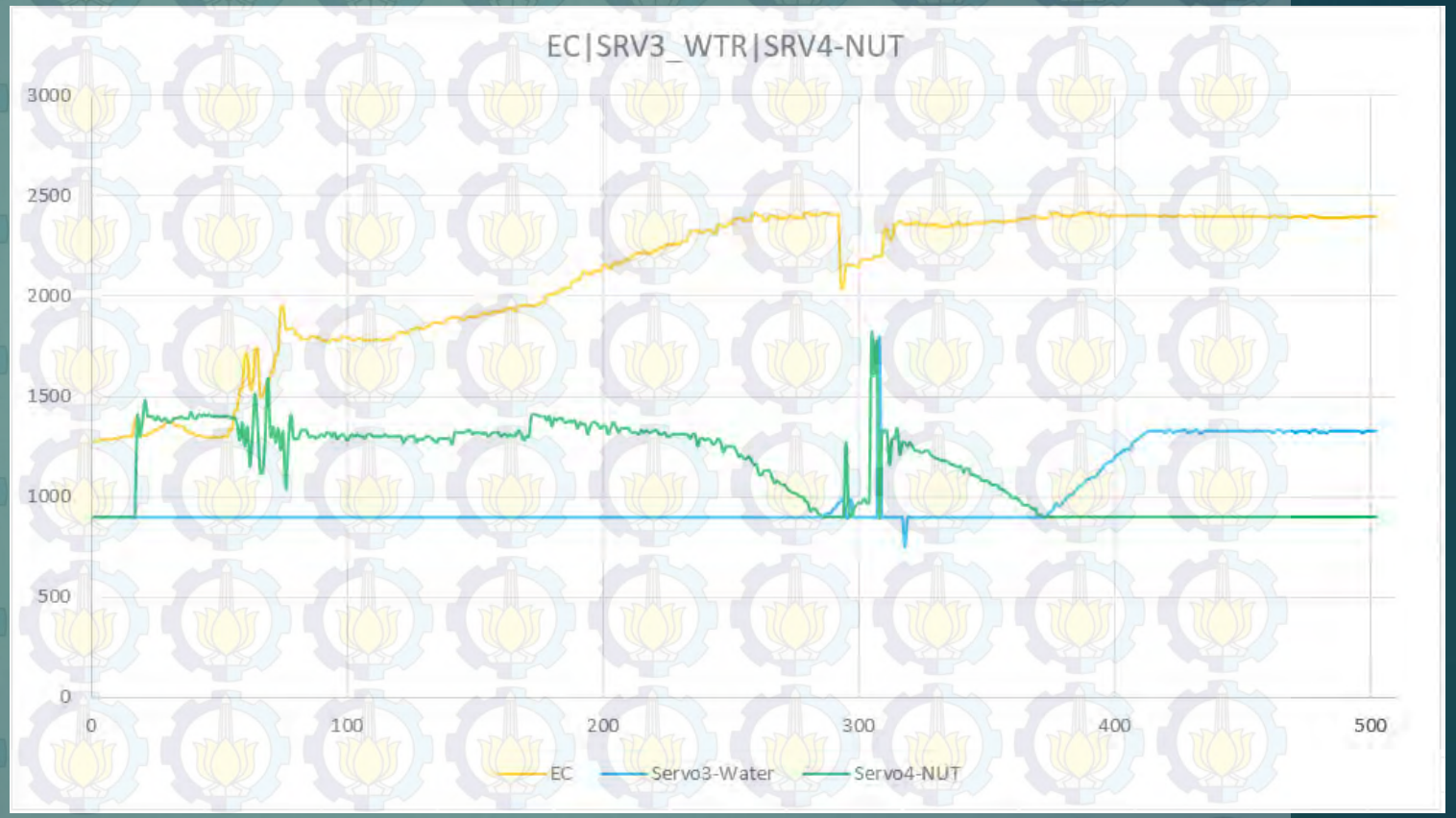


PENGUJIAN | Kontrol pH&EC -1

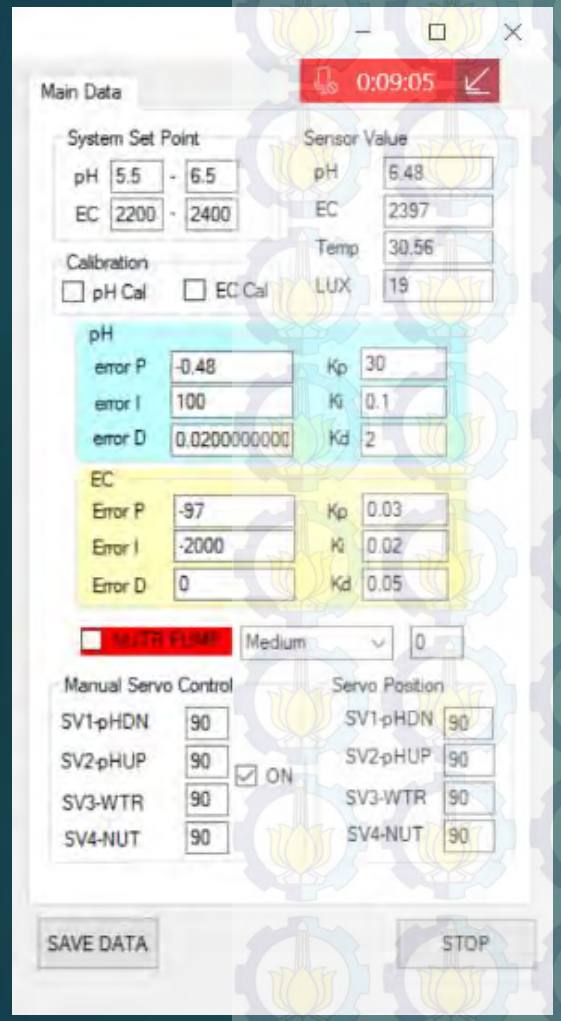


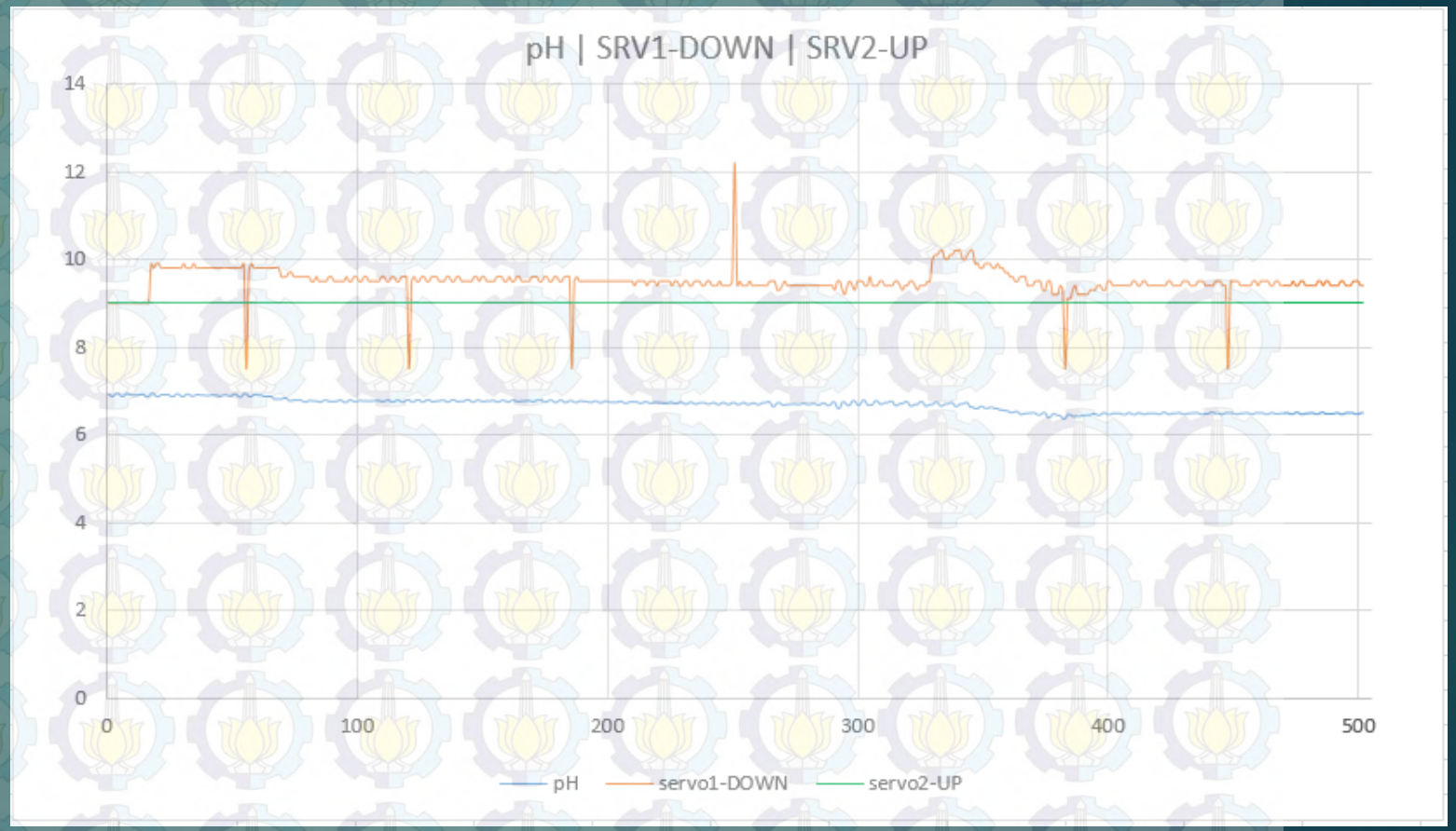


PENGUJIAN | Kontrol pH&EC -2



PENGUJIAN | Kontrol pH&EC -2





KESIMPULAN

- Sistem control hidroponik yang dirancang secara garis besar sudah dapat mengejar nilai set point EC dan pH yang ditentukan dengan error rata – rata berkisar 500uS untuk EC dan 1 untuk pH.
- Secara elektronik system sudah berfungsi sesuai yang diharapkan. Kekurangan kinerja sistem dikarenakan system mekanik keran modifikasi dengan servo dan botol nutrisi yang kurang sempurna (terlalu berat, tidak seragam, terpengaruh gravitasi).
- Pengukuran nilai intensitas cahaya tidak berhasil mendekati nilai yang seharusnya sedangkan pengukuran suhu berhasil mengukur suhu dengan nilai error dibawah 1%.

TERIMA KASIH