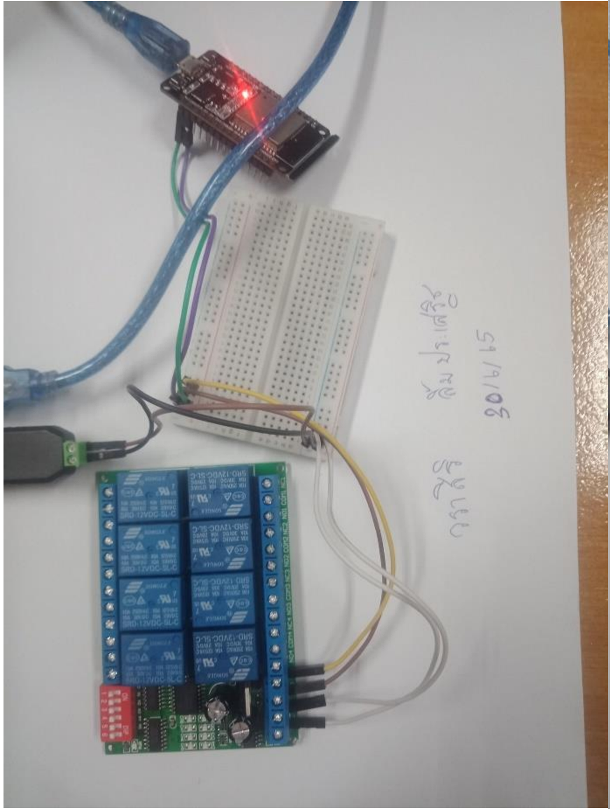
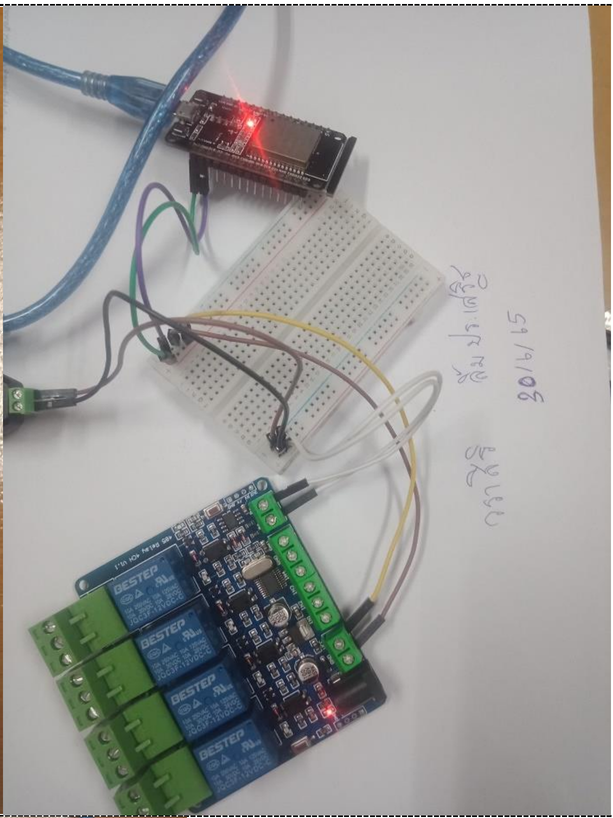
การควบคุมเครื่องจักรอัจฉริยะโดยใช้การสื่อสารระหว่างเครื่องจักรกับเครื่องจักร
M2M - Intelligence Machine Control

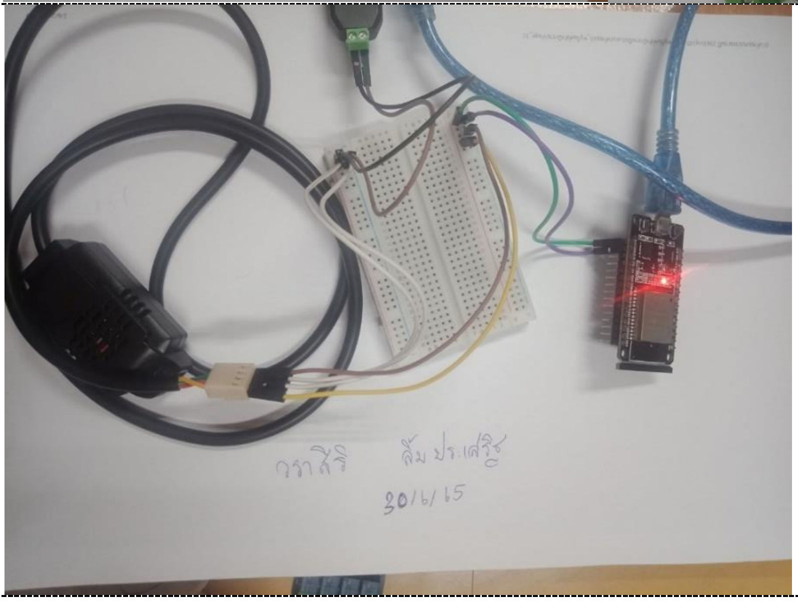
ชื่อ-สกุล : วราสิริ ลิ้มประเสริฐ B6214005

4/4: -- คำถามท้ายบทเพื่อทดสอบความเข้าใจ

Quiz_201 – Read Modbus RTU







```
#include "ModbusMaster.h" //https://github.com/4-20ma/ModbusMaster
#define Slave_ID 1
#define MAX485_RE_NEG 4
#define RX_PIN 16
#define TX_PIN 17
ModbusMaster modbus;
void preTransmission() {
  digitalWrite(MAX485_RE_NEG, HIGH); //Switch to transmit data
}
void postTransmission() {
  digitalWrite(MAX485_RE_NEG, LOW); //Switch to receive data
}
void setup() {
  pinMode(MAX485_RE_NEG, OUTPUT);
  digitalWrite(MAX485_RE_NEG, LOW);
  Serial.begin(115200, SERIAL_8N1);
  Serial2.begin(9600, SERIAL_8N1, RX_PIN, TX_PIN);
  modbus.begin(Slave_ID, Serial2);
  modbus.preTransmission(preTransmission);
  modbus.postTransmission(postTransmission);
}
long lastMillis = 0;
void loop() {
  long currentMillis = millis();
  if (currentMillis - lastMillis > 1000) {
    uint8_t result = modbus.readHoldingRegisters(0, 2);
    if (getResultMsg(&modbus, result)) {
      Serial.println();
      double res_dbl = modbus.getResponseBuffer(0) / 10;
      String res = "Temperature: " + String(res_dbl) + " C\r\n";
      res_dbl = modbus.getResponseBuffer(1) / 10;
      res += "Humidity: " + String(res_dbl) + " %";
      Serial.println(res);
    }
    lastMillis = currentMillis;
  }
}
bool getResultMsg(ModbusMaster *node, uint8_t result) {
  String tmpstr2 = "\r\n";
  switch (result) {
    case node->ku8MBSuccess:
      return true;
      break;
    case node->ku8MBIllegalFunction:
      tmpstr2 += "Illegal Function";
      break;
    case node->ku8MBIllegalDataAddress:
      tmpstr2 += "Illegal Data Address";
      break;
    case node->ku8MBIllegalDataValue:
      tmpstr2 += "Illegal Data Value";
      break;
    case node->ku8MBSlaveDeviceFailure:
      tmpstr2 += "Slave Device Failure";
      break;
    case node->ku8MBInvalidSlaveID:
      tmpstr2 += "Invalid Slave ID";
      break;
    case node->ku8MBInvalidFunction:
      tmpstr2 += "Invalid Function";
      break;
    case node->ku8MBResponseTimedOut:
      tmpstr2 += "Response Timed Out";
      break;
    case node->ku8MBInvalidCRC:
      tmpstr2 += "Invalid CRC";
      break;
    default:
      tmpstr2 += "Unknown error: " + String(result);
      break;
  }
  Serial.println(tmpstr2);
  return false;
}
```

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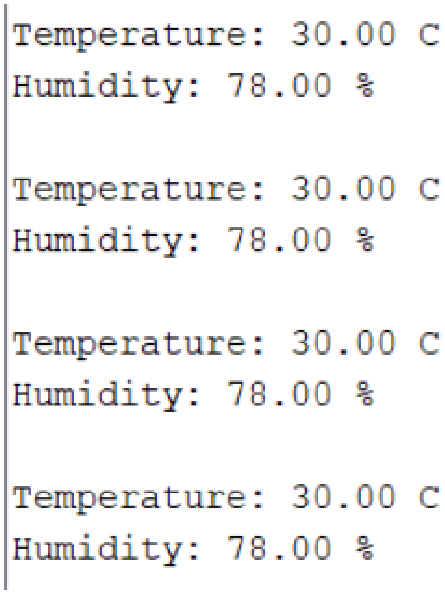
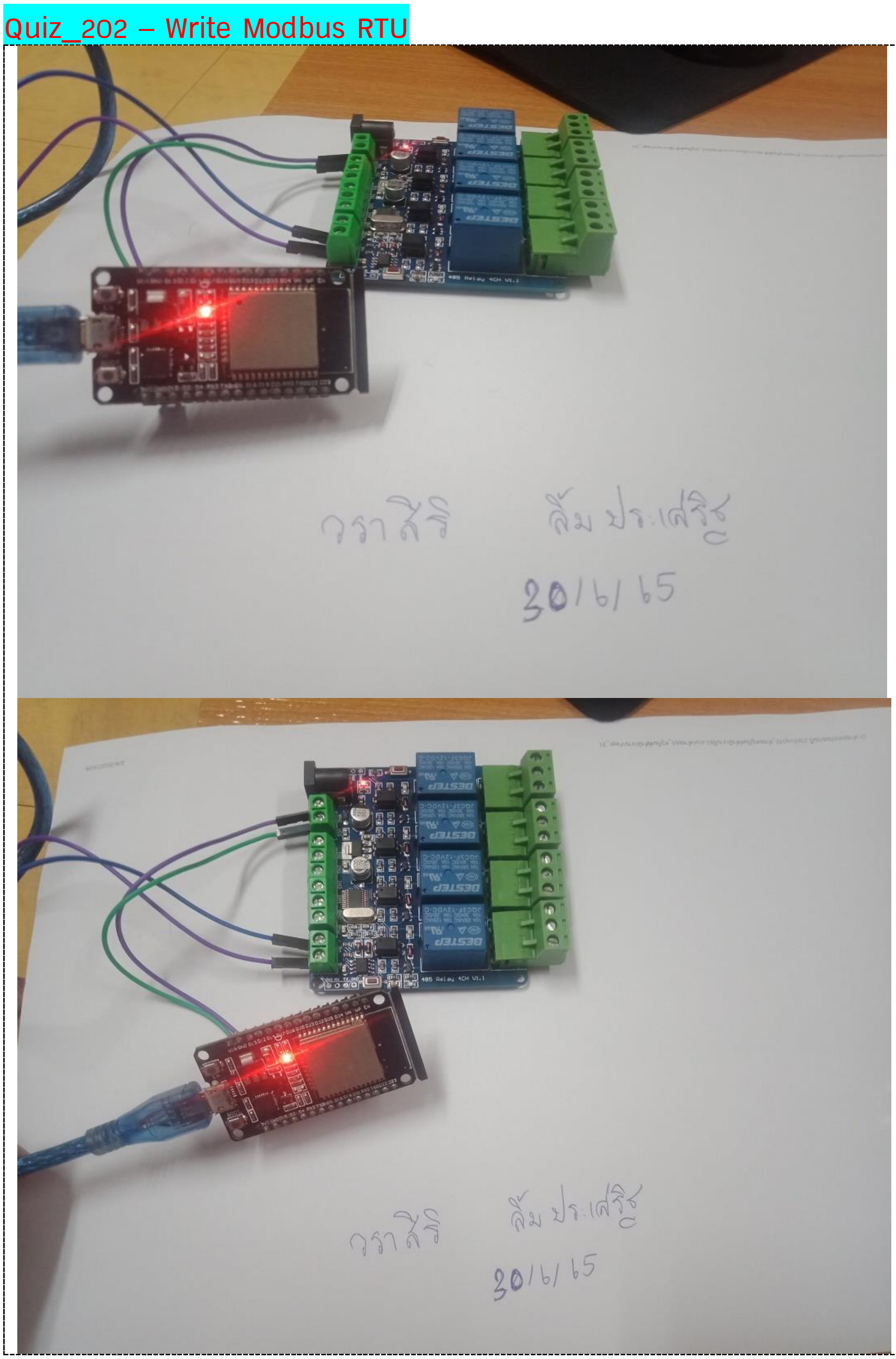
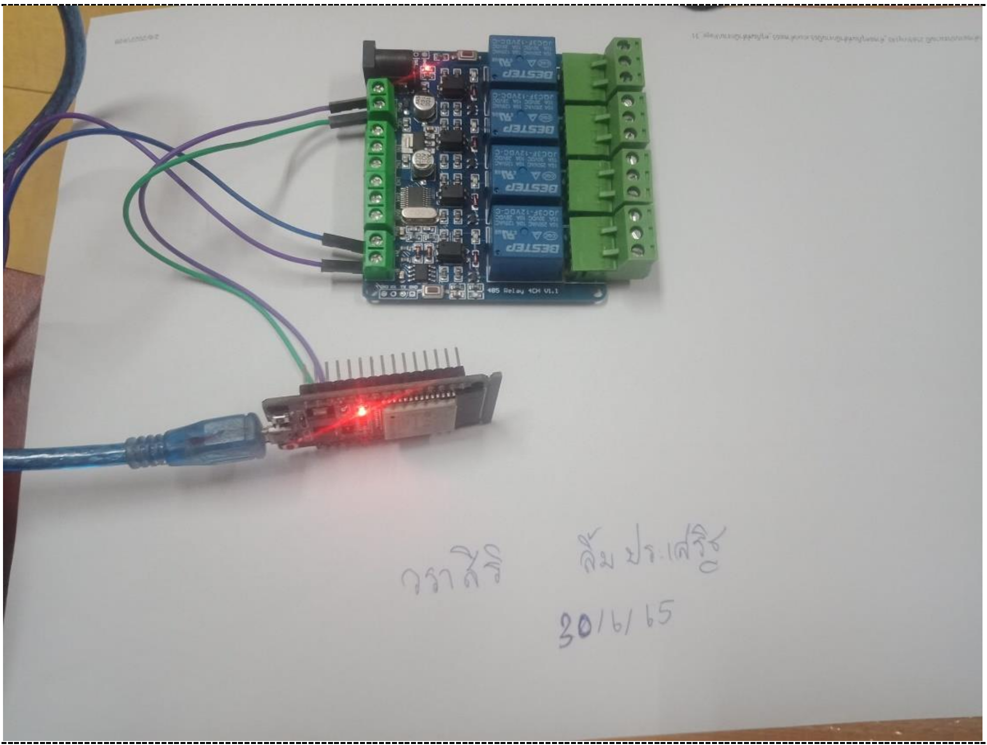


```
Temperature: 30.00 C
Humidity: 78.00 %

Temperature: 30.00 C
Humidity: 78.00 %

Temperature: 30.00 C
Humidity: 78.00 %

Temperature: 30.00 C
Humidity: 78.00 %
```

Quiz_202 – Write Modbus RTU





< Source Code >

```
#define RS485Transmit HIGH
#define RS485Receive LOW
#define RS485Control 4 //RS485 Direction control
#define Pin_LEDMonitor 2
byte Board_ID = 0x05; // ID = 5
byte Mdbs_Cmd = 0x05; // Command 05
byte H_RelayID = 0x00;
byte L_RelayID = 0x00;
byte Relay_On = 0x01; // On = 0100
byte Relay_Off = 0x00; // Off = 0000
byte OnOff_Dly = 0x00;
byte HByte_CRC = 00;
byte LByte_CRC = 00;
int StepConut = 0;
byte Echo[20];
void setup() {
  pinMode(Pin_LEDMonitor, OUTPUT);
  pinMode(RS485Control, OUTPUT);
  Serial.begin(115200);
  Serial2.begin(9600);
  digitalWrite(RS485Control, RS485Receive);
  Serial.println("Start Test MODBUS RTU");
}
uint16_t CRC16_Update(uint16_t tempCRC, uint8_t inData) {
  tempCRC ^= inData;
  for (int i = 0; i < 8; ++i)
    if (tempCRC & 1) tempCRC = (tempCRC >> 1) ^ 0xA001;
    else tempCRC = (tempCRC >> 1);
  return tempCRC;
}
uint16_t SendByte_CRCUpdate(uint16_t tempCRC, uint8_t inData) {
  Serial2.write(inData);
  if (inData < 0x10) Serial.print("0");
  Serial.print(inData, HEX);
  Serial.print(" ");
  tempCRC = CRC16_Update(tempCRC, inData);
  return tempCRC;
}
void RTU_RelayCtrl(int rly_ID, byte rly_Cmd) {
  uint16_t Calc_CRC = 0xffff; // the initial value
  H_RelayID = highByte(rly_ID);
  L_RelayID = lowByte(rly_ID);
  digitalWrite(Pin_LEDMonitor, HIGH);
  digitalWrite(RS485Control, RS485Transmit); delay(10);
  Calc_CRC = SendByte_CRCUpdate(Calc_CRC, Board_ID);
  Calc_CRC = SendByte_CRCUpdate(Calc_CRC, Mdbs_Cmd);
  Calc_CRC = SendByte_CRCUpdate(Calc_CRC, H_RelayID);
  Calc_CRC = SendByte_CRCUpdate(Calc_CRC, L_RelayID);
  Calc_CRC = SendByte_CRCUpdate(Calc_CRC, rly_Cmd);
  Calc_CRC = SendByte_CRCUpdate(Calc_CRC, OnOff_Dly);
  HByte_CRC = highByte(Calc_CRC);
  LByte_CRC = lowByte(Calc_CRC);
  Calc_CRC = SendByte_CRCUpdate(Calc_CRC, LByte_CRC);
  Calc_CRC = SendByte_CRCUpdate(Calc_CRC, HByte_CRC);
  delay(10);
  digitalWrite(RS485Control, RS485Receive);
  digitalWrite(Pin_LEDMonitor, LOW);
  Serial.println();
}
void loop() {
  RTU_RelayCtrl(0, Relay_On); delay(3000);
  RTU_RelayCtrl(1, Relay_On); delay(3000);
  RTU_RelayCtrl(2, Relay_On); delay(3000);
  RTU_RelayCtrl(3, Relay_On); delay(3000);
  RTU_RelayCtrl(0, Relay_Off); delay(3000);
  RTU_RelayCtrl(1, Relay_Off); delay(3000);
  RTU_RelayCtrl(2, Relay_Off); delay(3000);
  RTU_RelayCtrl(
}
```

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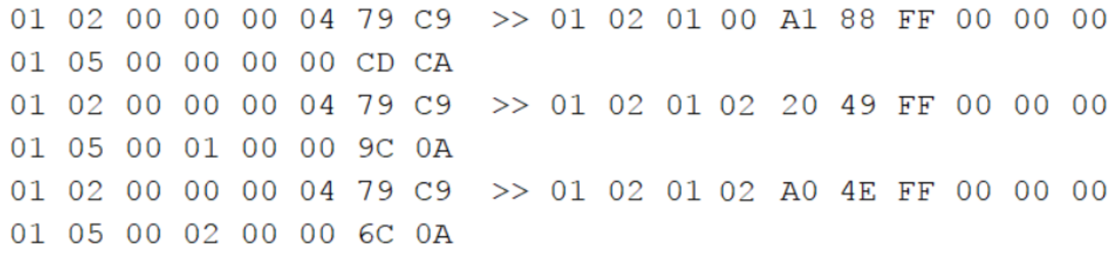
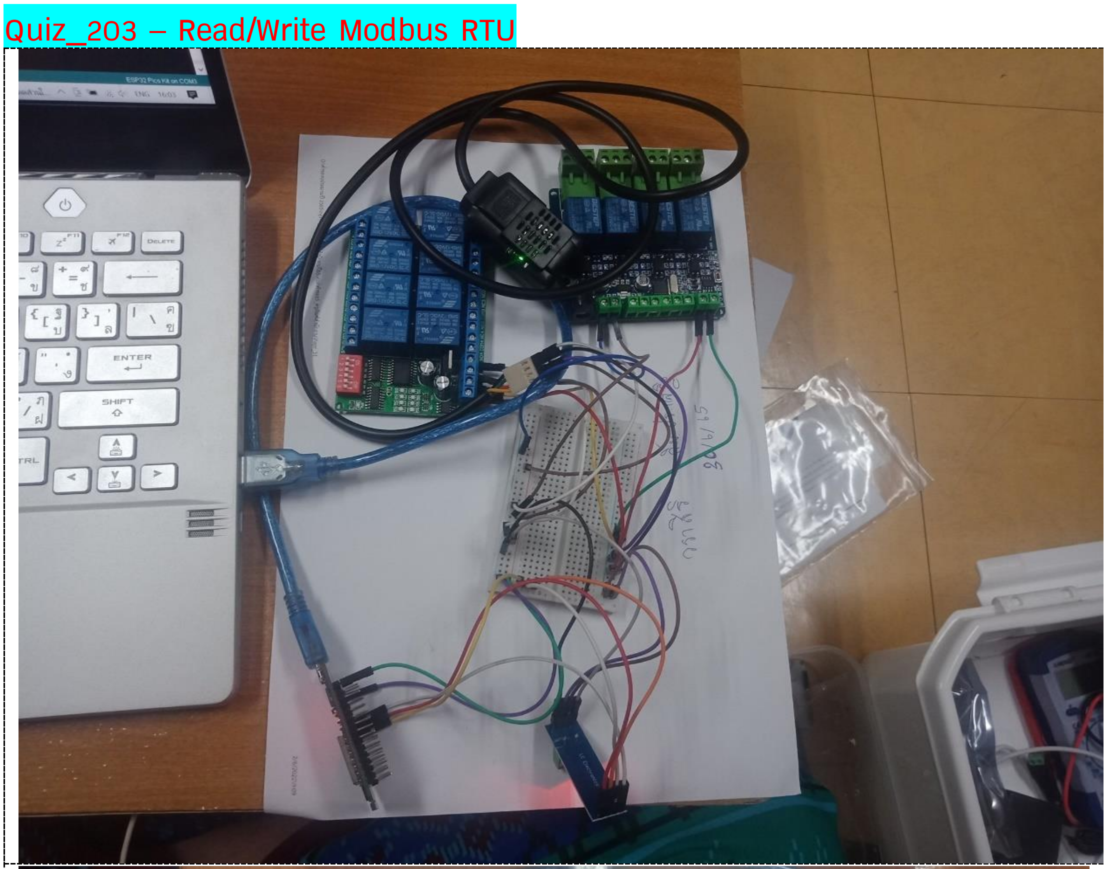
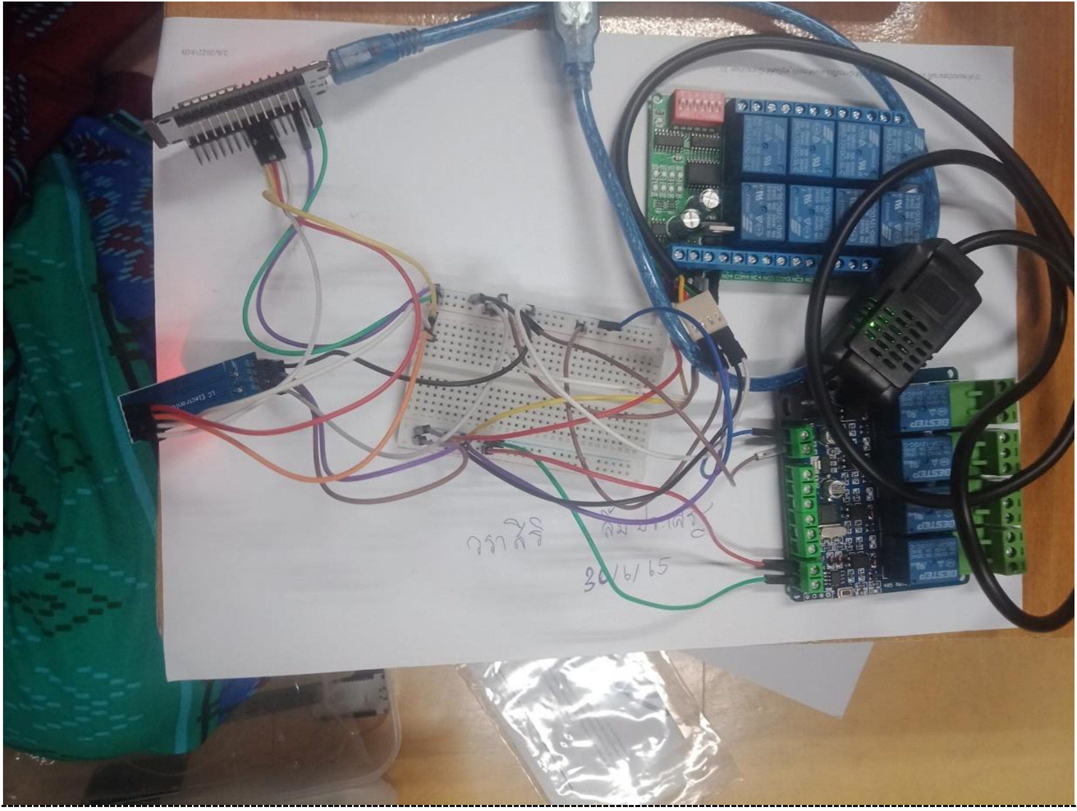


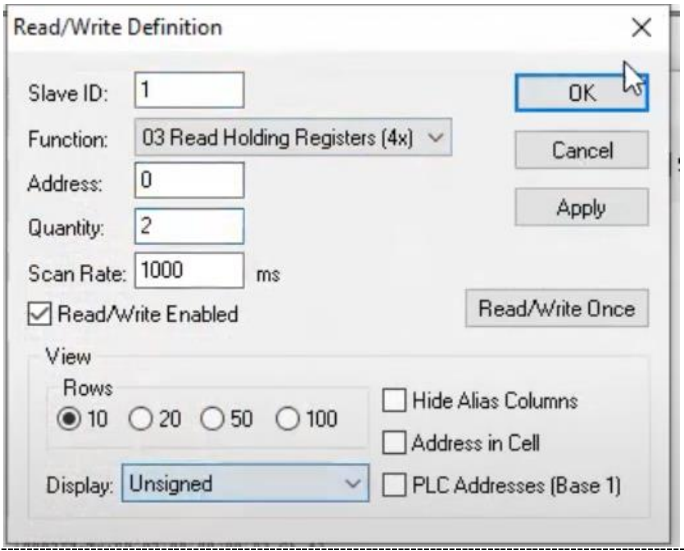
```
01 02 00 00 00 04 79 C9  >> 01 02 01 00 A1 88 FF 00 00 00
01 05 00 00 00 00 CD CA
01 02 00 00 00 04 79 C9  >> 01 02 01 02 20 49 FF 00 00 00
01 05 00 01 00 00 9C 0A
01 02 00 00 00 04 79 C9  >> 01 02 01 02 A0 4E FF 00 00 00
01 05 00 02 00 00 6C 0A
```

Quiz_203 – Read/Write Modbus RTU





เซ็ตค่าใน Read/Write Definition



Read/Write Definition

Slave ID: 1

Function: 03 Read Holding Registers (4x)

Address: 0

Quantity: 2

Scan Rate: 1000 ms

☑ Read/Write Enabled

View

Rows ● 10 ○ 20 ○ 50 ○ 100

Display: Unsigned

□ Hide Alias Columns

□ Address in Cell

□ PLC Addresses (Base 1)

<Source Code>

```
#include <ModbusMaster.h>
#define RS485Transmit HIGH
#define RS485Receive LOW
#define RS485Control 4 //RS485 Direction control
#define Pin_LEDMonitor 2
#define Slave_Sensor_ID 1
#define Slave_Relay8_ID 3
#define Slave_Ry4In4_ID 5
int state = 0;
float CTempp, Hudmid;
bool DgInput0, DgInput1, DgInput2, DgInput3;
ModbusMaster node_Sensor;
ModbusMaster node_Relay8;
ModbusMaster node_Ry4In4;
void preTransmission() {
  digitalWrite(RS485Control, RS485Transmit);
}
void postTransmission() {
  digitalWrite(RS485Control, RS485Receive);
}
void setup() {
  pinMode(RS485Control, OUTPUT);
  pinMode(Pin_LEDMonitor, OUTPUT);
  Serial.begin(115200);
  Serial2.begin(9600);
  postTransmission();
  node_Sensor.begin(Slave_Sensor_ID, Serial2); // Modbus slave ID=1
  node_Sensor.preTransmission(preTransmission);
  node_Sensor.postTransmission(postTransmission);
  node_Relay8.begin(Slave_Relay8_ID, Serial2); // Modbus slave ID=3
  node_Relay8.preTransmission(preTransmission);
  node_Relay8.postTransmission(postTransmission);
  node_Ry4In4.begin(Slave_Ry4In4_ID, Serial2); // Modbus slave ID=5
  node_Ry4In4.preTransmission(preTransmission);
  node_Ry4In4.postTransmission(postTransmission);
}
```

```
void ReadTemperature(void) {
  uint8_t result;
  // Toggle the coil at address (Manual Load Control)
  result = node_Sensor.writeSingleCoil(Slave_Sensor_ID, state);
  state = !state;
  // Read 2 registers starting at 0x0000)
  result = node_Sensor.readInputRegisters(0x0000, 2); // From=0, nByte=2
  if (result == node_Sensor.ku8MBSuccess) {
    CTempp = node_Sensor.getResponseBuffer(0x00) / 10.0f;
    Hudmid = node_Sensor.getResponseBuffer(0x01) / 10.0f;
  }
}
void ReadDigitalInput(void) {
  uint8_t result;
  // Toggle the coil at address (Manual Load Control)
  result = node_Ry4In4.writeSingleCoil(Slave_Sensor_ID, state);
  state = !state;
  // Read 4 registers starting at 0x0000)
  result = node_Ry4In4.readDiscreteInputs(0, 4); // Start=0, nByte=4
  if (result == node_Ry4In4.ku8MBSuccess) {
    int DgTemp = node_Ry4In4.getResponseBuffer(0x00);
    DgInput3 = (DgTemp >> 3) & 1;
    DgInput2 = (DgTemp >> 2) & 1;
    DgInput1 = (DgTemp >> 1) & 1;
    DgInput0 = (DgTemp >> 0) & 1;
  }
}
void RelayControl(int inputCase) {
  int rnMode = inputCase / 10;
  int nRelay = inputCase % 10;
  if (rnMode == 81) node_Relay8.writeSingleRegister(nRelay, 0x0100); // On RelayX
  if (rnMode == 80) node_Relay8.writeSingleRegister(nRelay, 0x0200); // Off RelayX
  if (rnMode == 41) node_Ry4In4.writeSingleRegister(nRelay, 0x0100); // On RelayX
  if (rnMode == 40) node_Ry4In4.writeSingleRegister(nRelay, 0x0000); // Off RelayX
}
void loop() {
  ReadTemperature();
  ReadDigitalInput();
  Serial.print("\n Tempp('C): "); Serial.print(CTempp, 2);
  Serial.print(", Humid(%): "); Serial.print(Hudmid, 2);
  Serial.print(", Sensor[0:3]: "); Serial.print(DgInput3);
  Serial.print("-"); Serial.print(DgInput2);
  Serial.print("-"); Serial.print(DgInput1);
  Serial.print("-"); Serial.print(DgInput0);
  if (Serial.available() > 0) {
    int DataInput = Serial.parseInt();
    Serial.print("\n >> XYZ > X={8,4}Board Name, Y={1,0}On,Off, Z={0-8}RlyID >> ");
    Serial.println(DataInput);
    RelayControl(DataInput);
  }
  delay(2000);
}
```

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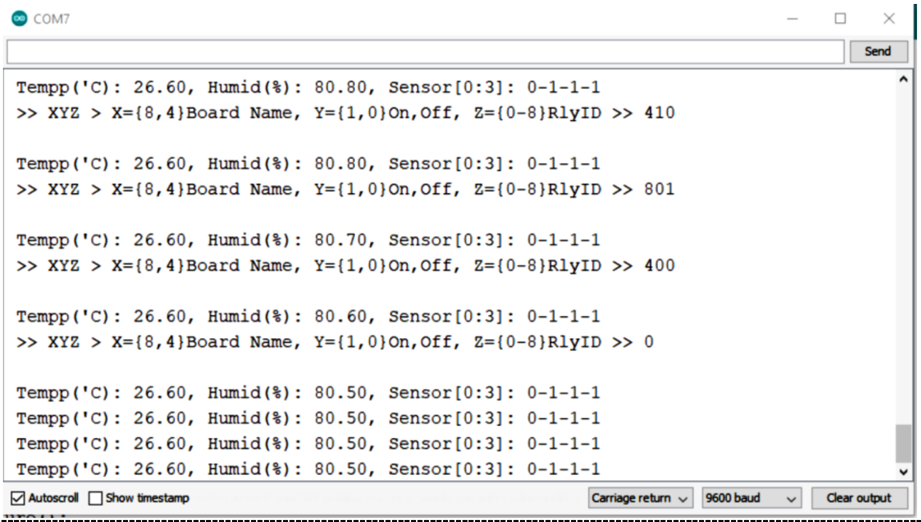

```
Tempp('C): 26.60, Humid(%): 80.80, Sensor[0:3]: 0-1-1-1
>> XYZ > X={8,4}Board Name, Y={1,0}On,Off, Z={0-8}RlyID >> 410

Tempp('C): 26.60, Humid(%): 80.80, Sensor[0:3]: 0-1-1-1
>> XYZ > X={8,4}Board Name, Y={1,0}On,Off, Z={0-8}RlyID >> 801

Tempp('C): 26.60, Humid(%): 80.70, Sensor[0:3]: 0-1-1-1
>> XYZ > X={8,4}Board Name, Y={1,0}On,Off, Z={0-8}RlyID >> 400

Tempp('C): 26.60, Humid(%): 80.60, Sensor[0:3]: 0-1-1-1
>> XYZ > X={8,4}Board Name, Y={1,0}On,Off, Z={0-8}RlyID >> 0

Tempp('C): 26.60, Humid(%): 80.50, Sensor[0:3]: 0-1-1-1
Tempp('C): 26.60, Humid(%): 80.50, Sensor[0:3]: 0-1-1-1
Tempp('C): 26.60, Humid(%): 80.50, Sensor[0:3]: 0-1-1-1
Tempp('C): 26.60, Humid(%): 80.50, Sensor[0:3]: 0-1-1-1
```

☑ Autoscroll □ Show timestamp Carriage return 9600 baud

Quiz_204 – PLC Test

ไม่มีอุปกรณ์ที่ใช้ในการทดลอง จึงไม่สามารถเอามาลงให้ได้