

Table of Contents

Foreword.....	6
Valoratives	7
Transversal (Cognitive, Interdisciplinary and Investigative)	7
Chapter 1: Introduction to automation	22
Introduction	22
Redo and Reset!	23
The analysis of unit operations in order to automate ..	24
Basic principles of industrial automation	34
Individual automation	35
Centralized automation	35
Distributed automation	36
Continuous processes	37
Batch processes	37
Individual process	37
Elements of automation	39
Action / Sensing (sensor) Level	41
Supervision level (Plant Level)	56
Management level (Factory level)	59
Chapter 2: Basics Concepts of Industrial Communications	61
Data Transfer in Industrial Environments	61
Types of signals	62

Physical medium.....	62
Number of channels.....	64
The OSI model.....	64
Data Communication.....	66
Time and Transmission.....	68
Protocols or Field Buses	82
Typical terminology and material found on a fieldbus	84
Hierarchical structure of industrial communications.....	89

Chapter 3: Main Field Protocol Technical

Characteristics	92
I2C communication protocol.....	92
Examples of components and/or equipment that use the I2C Bus.....	97
SPI communication protocol.....	100
Examples of components and/or equipment that use SPI Bus	104
Hart communication protocol.....	104
The Hart protocol in the OSI model.....	106
The Hart signal	106
Transmission Mode and Format via Hart protocol...	108
The evolution of the Hart protocol	112
Examples of components and/or equipment that use the Bus Hart	113
ASI Communication protocol - SERIPLEX.....	115
Example of component and/or equipment used by the AS-i Bus	122
Example of component and/or equipment used by the Seriplex Bus.....	124
CAN-Bus communication protocol	125
Example of component and/or equipment used by the CAN Bus.....	130

Modbus communication protocol	132
Physical medium	133
Access to the Medium	133
Protocol	133
The Request.....	134
The Response.....	134
Modbus Addressing.....	135
Function codes	136
Example 3.1 Implementation of a modbus communications network.	136
Profibus communication protocol	142
Rockwell communication protocols	145
Devicenet.....	147
Controlnet.....	151
Ethernet.....	152

Chapter 4: Scada system and principles to enter supervision	155
The Scada System	155
Facility Remote Control.....	156
Information processing	156
Presentation of Dynamic Graphics.....	156
Generating Reports.....	157
Presentation of Alarms.....	157
Storage of Historical Information	157
Presentation of Trend Graphs	157
Event Programming.....	157
Introduction to OPC Server	159
Bibliographic references.....	162
Appendices	167

Practical exercise No. 1.....	168
RS232 Supported Serial Communication	
Development Instructions	168
Objectives.....	168
References	168
Introduction.....	169
Transmission speed (baud rate)	169
Data bits.....	170
Stop bits	170
Parity.....	170
RS-232.....	170
Microcontroller programming to transmit to the PC ...	171
 Practical exercise No. 2.....	 175
Serial Digital Data Transmission Through FSK	
Modulation Instructions	175
Objectives.....	175
References	175
General Description.....	176
Transmitter prototype development- FSK receiver	177
The digital sequence to be transmitted	178
Implementation	179
Bit clock generator	179
Scroll log and frame generation	180
XR-2206 modulator	182
Channel adaptation.....	183
Communication channel	184
XR-2211 Demodulator	185
 Practical Exercise No. 3.....	 187
Development of an I2C Communication with	
Labview for Analog Channel Reading.....	187

Instructions.....	187
Objectives.....	187
Introduction.....	187
Development of the Communication Protocol.....	188
USB Connector.....	191
Interface Between LabVIEW® and the I2C Communication Protocol	192
Practical Exercise No. 4.....	194
Serial Communication between a Mega Arduino - Pc For Type K Thermocoupler Reading Via SPI.....	194
Instructions.....	194
Objectives	194
References	194
SPI Serial Communication	195
USB Serial Communication.....	197
MAX6675 Module	197
Arduino Mega.....	198
Process	199
Final Considerations.....	203
Practical exercise No. 5.....	204
Development and Implementation of an Spi-Can Communication Instructions	204
Objective	204
References	204
Necessary Elements.....	205
Introduction.....	205
Theoretical Foundation	206
CAN communication	206
Practical Development	210
Arduino One Programming (set of 2).....	211

Communication Conversion (SPI/CAN and CAN/SPI)	216
3.3 Schematic diagram to assemble	217
Recommendations	220
Practical Exercise No. 6	221
Communication between a CLICK Koyo PLC and a ModBus Board RTU Via RS485 Relay	221
Instructions.....	221
Objectives.....	221
Specific objectives	221
References	222
Introduction.....	222
Theoretical Framework.....	223
Modbus.....	223
PLC	225
RELAY MODBUS BOARD RTU.....	226
Procedure for a Modbus Network Implementation	227
Relay Module Preparation	228
Slave Configuration and Programming (CLICK Koyo PLC).....	231
Practical Exercise No. 7	238
Communication between an HMI 5056N Screen and a CLICK Koyo Via Modbus PLC.....	238
Instructions.....	238
Objective	238
Specific objectives	238
References	239
Introduction.....	239
Theoretical Framework	240
Modbus.....	240

PLC	240
HMI screen	241
Procedure for the Implementation of a Modbus	
Network	242
Slave programming (plc click koyo)	243
Code Description	244
Master configuration and programming (hmi	
5056n)	249
Gauge and Display indicator	253
Meter Display Configuration	254
Numeric Display Settings	255
Indicator and virtual potentiometer	256
Practical Exercise No. 8	260
Communication between ATV71 Variator and	
TWIDO PLC Via Modbus, Using Macro Drive	260
Instructions	260
Objectives	260
References	261
Modbus Protocol	261
Exercise. Implementation of a modbus network	262
Master configuration (twido)	262
Open Twido Suite software	263
Configure components ports	264
Configure macro drive	266
Select the Modbus-Port 1 network channel and	
the address in the network	267
Program: go to edit program	268
Animation of tables	269
Configure atv71 speed drive parameters	269
Authors	271