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 MANIPAL INSTITUTE OF TECHNOLOGY

 MANIPAL

A Constituent Institution of Manipal University

V SEMESTER B.TECH. (MECHATRONICS ENGINEERING) END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: PROGRAMMABLE LOGIC CONTROLLER

[MTE 3104]

REVISED CREDIT SYSTEM (29/11/2016)

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Missing data may be suitable assumed.
- 1A. Write a ladder logic program for the following process. When a button A is pushed, a light 04 will flash for 5 seconds. The flashing light will be on for 0.25 sec and off for 0.75 sec. If A has been pushed 5 times the light will not flash until the system is reset. The system can be reset by pressing button B. Draw appropriate timing diagram.
- **1B.** What is SCADA? Explain the basic types of architecture related to SCADA with suitable **04** sketches. Reason why is PLC recommended for SCADA?
- **1C.** Explain the two types of latching circuits with relevant examples.
- 2A. Elucidate the underlying principle of operation of HART with a neat diagram. Also describe 03 the communication modes involved in the operation of HART.
- 2B. Develop a ladder logic program that will latch on an output B, 20 seconds after input A has 04 been turned on. The timer will continue to cycle up to 20 seconds, and reset itself, until A has been turned off. After the third time the timer has timed to 20 seconds, B will be unlatched.
- Sketch and explain the concept of sourcing and sinking with respect to the output module of a 03 PLC.
- 3A. Construct a ladder logic diagram that will implement the following function. If the result is 03 greater than 100 then an output light 'P' will be turned on. Assume A, B and C are inputs. $X = \ln[10 + A(B\cos^{-1}(4C + 5))^2]$
- **3B.** With a neat block diagram explain the operation of an Off Delay timer.

02

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- **3C** Using suitable ladder logic, design a conveyor control system that follows the design **05** guidelines below. Show appropriate labelling and addressing.
 - The conveyor has an optical sensor S1 that detects boxes entering a work cell
 - There is also an optical sensor S2 that detects boxes leaving the work cell
 - The boxes enter the work cell on a conveyor controlled by output C1
 - The boxes exit the work cell on a conveyor controlled by output C2
 - The controller must keep a running count of boxes using the entry and exit sensors
 - If there are more than five boxes in the work cell the entry conveyor will stop
 - If there are no boxes in the work cell the exit conveyor will be turned off
 - If the entry conveyor has been stopped for more than 30 seconds the count will be reset to zero assuming that the boxes in the work cell were scrapped
- **4A.** What do you mean by the term redundancy? Explain the relevance of redundancy in the **04** design of PLC and elaborate the different types of redundant PLCs with suitable sketches.
- **4B.** Write a short note on contactors. Use suitable sketches wherever required. **03**
- 4C. In dangerous processes it is common to use two palm buttons that require an operator to use 03 both hands to start a process (this keeps hands out of presses, etc.). To develop this there are two inputs that must be turned on within 0.25s of each other before a machine cycle may begin. A master control turns the system on and off. Draw a ladder diagram to simulate this scenario.
- 5A. Implement a ladder logic circuit for the following scenario with proper addresses and labels. 04 A temperature control system consists of three bimetallic thermostats (thermostats are deenergized (LOW) when the set point is reached). The system operates three heaters. Thermostats are set at 50°C, 60°C and 70 °C. Below 50°C three heaters are to be on. A temperature between 50°C and 60°C causes two heaters to be on. For temperatures between 60°C and 70°C only one heater is to be on. Above 70°C all heaters should be off. A buzzer is to be sounded and a safety shutoff should be energized and when temperature reaches 80°C making all three heaters off in case on stays on by mistake. A master control turns the system on and off.
- **5B.** Simulate the EX-OR gate using PLC ladder logic. Also draw the digital circuit. **03**
- 5C. A new printing station will add a logo to parts as they travel along an assembly line. When a part arrives a 'part' sensor will detect it. After this the 'clamp' output is turned on for 10 seconds to hold the part during the operation. For the first 2 seconds the part is being held a 'spray' output will be turned on to apply the thermoset ink. For the last 8 seconds a 'heat' output will be turned on to cure the ink. After this the part is released and allowed to continue along the line. Develop a ladder logic diagram for this process.