MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal)

# SIXTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.) END SEMESTER DEGREE EXAMINATION, APRIL/MAY - 2019

## SUBJECT: INDUSTRIAL AUTOMATION [ICE 3201]

#### TIME: 3 HOURS

#### MAX. MARKS: 50

### Instructions to candidates : Answer ALL questions and missing data may be suitably assumed.

- 1A With necessary diagrams describe smart sensors and multivariable loop controllers.
- 1B Pressure in psi is measured and converted to voltage by a sensor according to the relationship,

V = 3.1[p + 10]1/2 - 9.8

The pressure range is 0 to 30 psi and the set point is 15 psi. This voltage is provided as input to an 8-bit unipolar ADC with a 10.00-volt reference, and the resulting binary is provided as input to a control computer. (a) Develop the equations used to find the pressure from the binary input and then the error. (b) Contrast the actual error with the computed sample error for a pressure of 20.7 psi.

1C A small computer requires 4  $\mu$ s per instruction and 100 instructions to address a multiplexer line and to read in and process the data in that line. The ADC performs the conversion in 30  $\mu$ s. The multiplexer requires 20  $\mu$ s to select and capture the value of an input line. Calculate the maximum sampling rate of a particular line if 12 analog loops are available in the system.

(4+4+2)

- 2A With the help of a block diagram illustrate how a sensor signal is collected from plant to PLC module.
- 2B Without simplification draw the equivalent ladder logic and instruction list program for the Boolean expression given below.

$$Y = (\overline{AB\bar{C}D + AB\bar{C}\bar{D} + \bar{A}BCD + \bar{A}\bar{B}CD}) + D$$

2C With an example, differentiate between ORB and OR B instructions.

(4+4+2)

- 3A A press machine contains a hydraulic cylinder to press the components. Two sensors are mounted at each end of the cylinder stroke to sense the position. Two separate coils are used for actuating forward and reverse strokes. Pressing a push button will continuously start forward and retraction strokes with 10 sec delay before each stroke. If any of the strokes take more than 5 seconds to reach other end, the cylinder is said to be stuck, so the machine has to shut down. Write a ladder logic and structured text programming for the above process.
- 3B Explain the working of Allen-Bradley TONR. Give a suitable example to illustrate the usage of the same and draw the timing diagram.
- 3C Differentiate skip and MCR functions with an example.

(4+4+2)

- 4A With neat diagram explain different modes of operation in HART protocol
- 4B Illustrate Profibus protocol architecture with necessary diagram.
- 4C With a diagram describe a small facility SCADA system.
- 5A Explain two transmission modes in MODBUS communication with their packet format.
- 5B Compare DCS with hybrid and central computer architecture with any four features.
- 5C Describe query response cycle in Modbus communication.

(4+4+2)

(4+4+2)

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