Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
END SEMESTER EXAMINATIONS, NOVEMBER 2019

INDUSTRIAL AUTOMATION AND CONTROL [ELE 4015]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 28 November 2019** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. What is the need for automation? Explain the level of automation employed in an automobile manufacturing industry from field to information technology level using the automation pyramid. ***(05)***

1B. Explain single speed and multi- speed floating control modes with suitable expressions. Also graphically show the control action variation with change in error below and above the neutral zone. ***(03)***

1C. A controller outputs a (4 to 20) mA signal to control motor speed from 140 to 600 rpm with a linear dependence. Calculate

(a) current corresponding to 310 rpm

(b) The value of current corresponding to 310 rpm expressed as the percent of control output. ***(02)***

2A. An olefin furnace shown in Figure Q2A is used to convert an ethane-propane mixture into a product stream rich in ethylene and propylene. The product stream is sent to an ethylene separation unit. Air and fuel are fed to the olefin furnace that heats the ethane feedstock to a specified temperature set point. To maximize olefin production, the temperature in the tubes should be tightly controlled even with changes in ethane feedstock composition and flow rate. The mixture of air and fuel should also be kept at a specified ratio.

(a) How might a sensor, actuator, and feedback control be used to address this control problem? Draw a block diagram for the feedback control.

(b) How might a sensor, actuator, and feed-forward control strategy be used to lessen the impact of a disturbance? Draw a block diagram for the feed-forward control that is added to the feedback controller.

(c) Explain the main difference between the feedback and feed-forward controls designed in the above cases. ***(03)***

2B. With suitable timing and block diagrams, explain the working of PLC Up/Down counter and Retentive OFF delay timer. ***(05)***

2C. With suitable examples explain briefly SKIP and MCR functions. ***(02)***

3A. Design a PLC ladder logic for a basic washing machine cycle. The machine needs to perform four basic functions in immediate succession, at gaps of one minute each:-

- filling water-10 mins
- Agitate soap and water-5 mins
- Spin to rinse-15 mins
- Spin to dry-10 mins

A sensor needs to detect the opening and closing of the doors such that the door is open at the beginning of the cycle and the washing operation will start only after door is manually closed. After the entire process is over, the door automatically opens again. Rest of the operations are automatic and done in the machine internally. An added feature of the machine is that it cannot take in more than fifteen clothes at a time. Each clothing article needs to be put onto a conveyor belt and fed into the machine. When fifteen clothes are detected, then an alarm sounds. Else the process must continue normally. Reset is done by pressing of a special RESET switch. ***(05)***

3B. A motor will be connected to a PLC and controlled by two switches. The GO switch will start the motor, and the STOP switch will stop it. (Consider GO switch as push button)

(i) If the motor is running, and the GO switch is pressed again then for this condition the motor will stop.

(ii) If the STOP switch was used to stop the motor, the GO switch must be pressed twice to start the motor again.

(iii) When the motor is running, a small lamp will be used for indication. ***(05)***

4A. Explain the three types of flow characteristics in a control valve with suitable plots. Also specify one example process for each. ***(05)***

4B. Explain the functionalities of reservoir and conducting lines in hydraulic actuator system. Also draw the symbols of various conducting lines. ***(03)***

4C. Explain briefly two advantages of Distributed Control System (DCS) with field bus in comparison with the conventional DCS. ***(02)***

5A. Explain the different system architectures of SCADA with neat block diagrams. Also list the merits and demerits of each. ***(05)***

5B. Explain the point-to-point and multi-drop communication modes of HART protocol. ***(03)***

5C. Explain the various functional blocks of a smart sensor with neat diagram ***(02)***

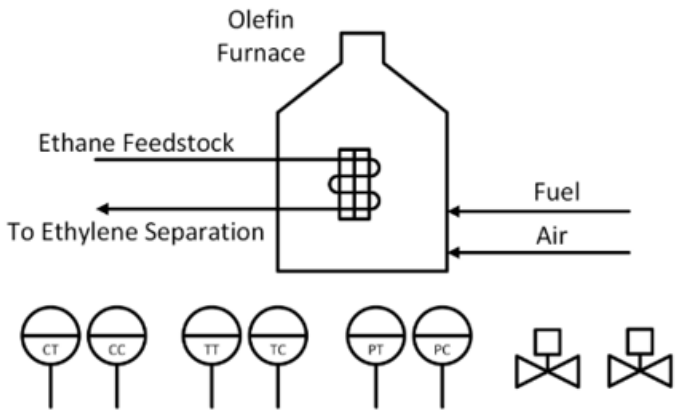

Figure Q2A