



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

ELECTRICAL ENGINEERING DEPARTMENT

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN TECHNOLOGY ELECTRICAL AND ELECTRONIC ENGINEERING

ECI 2305 PROCESS CONTROL SYSTEMS II:

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2019

TIME: 2 HOURS

DATE: Pick Date Select Month Pick Year

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **five** Questions; Question ONE is compulsory. In addition attempt any Other TWO Questions.

Do not write on the question paper.

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- Q1 a) i) Define:
- I) Manipulated variable
 - II) Self-regulation
 - III) Dead time
 - IV) Controller
 - V) Actuator
- ii) State and explain any **THREE** purposes of Process Control **(10 Marks)**
- b) i) State the analytic expression for a PI controller mode
- ii) With the aid of a circuit diagram, derive the output expression for the controller in **(10 Marks)**
- Q2 a) i) With the aid of a sketch explain the operation of an elementary stepping motor
- ii) Describe the following Control-Valve Types
- I) Quick opening Valve type
 - II) Linear Valve type
 - III) Equal Percentage type
- (16 Marks)**
- b) A stepper motor 10^0 per step and must rotate at 250rpm. Calculate the required input pulse rate in pulses per second. **(4 Marks)**

- Q3 a) i) With the aid of a labeled schematic diagram, explain the principle of operation of a hydraulic servo system.
- ii) State any **THREE** applications of a hydraulic
- iii) List any **TWO** disadvantages of a hydraulic system

(12 Marks)

- b) i) Study the pictorial process of Figure 1. Identify the input and output devices and the characteristics of each device.

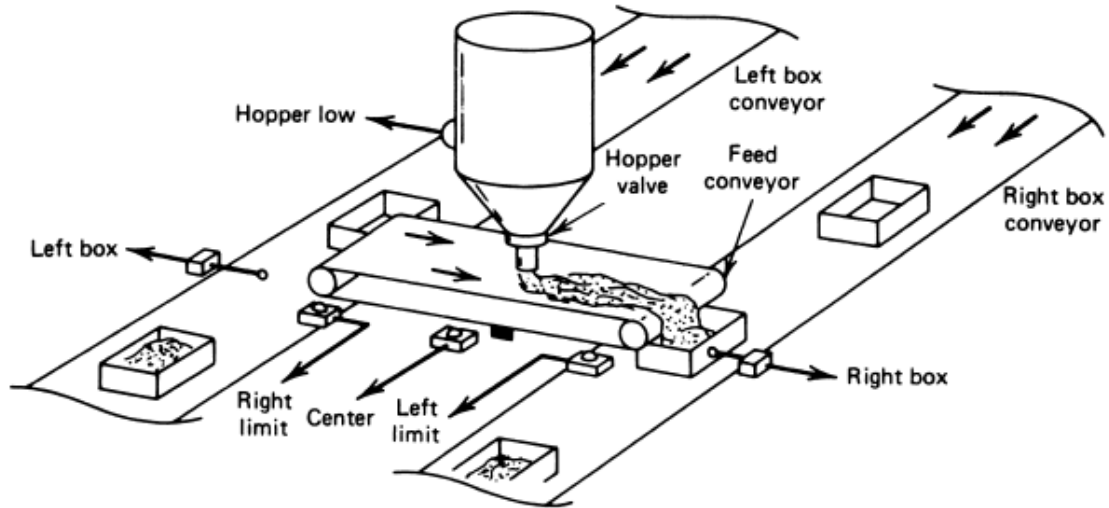


Fig. 1.0 a discrete-control process.

Study the pictorial process of Figure 1. Identify the input and output devices and the characteristics of each device.

(8 Marks)

- Q4 a) i) Explain with the aid of a diagram the principle of operation of a pneumatic Proportional-Integral mode controller
- ii) For the proportional pneumatic controller in a (i) if $A_1 = A_2 = 10 \text{ cm}^2$, $X_1 = 16 \text{ cm}$, and $X_2 = 10 \text{ cm}$. The input and output pressure ranges are 3 to 15 psi. Find the input pressures that will drive the output from 3 to 15 psi. The setpoint pressure is 8 psi, and, $P_0 = 10 \text{ psi}$. Find the proportional band.

(16 Marks)

- b) State the **FOUR** steps of controller settings involved in the Ziegler-Nichols Method.

(4 Marks)

- Q5 a) i) Explain with the aid of a block diagram the major components of a PLC
- ii) Explain reasons why PLC is preferred to conventional computers for industrial controls

(10 Marks)

- b) i) Prepare the physical and programmed ladder diagram for the control problem shown in Figure 2. The global objective is to heat a liquid to a specified temperature and keep it there with stirring for 30 min.

The hardware has the following characteristics:

1. START push button is NO, STOP is NC.
2. NO and NC are available for the limit switches.

The event sequence is

1. Fill the tank.
2. Heat and stir the liquid for 30 min.
3. Empty the tank.

4. Repeat from step 1.

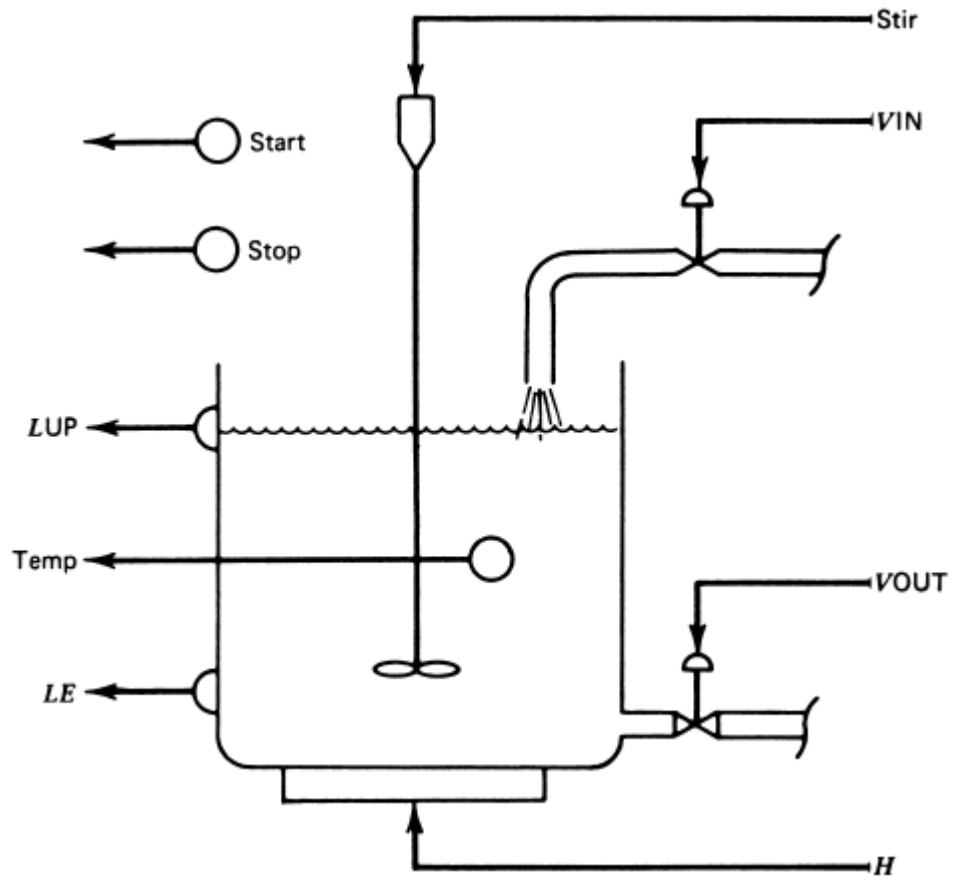


Fig 2. Tank system.

(10 Marks)