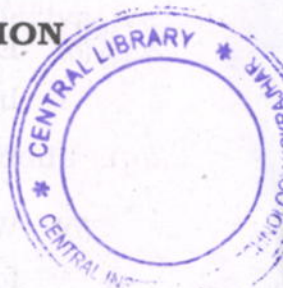**53 (IE 605) PRIC**

2019

PROCESS INSTRUMENTATION AND CONTROL

Paper : IE 605

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. (a) Explain the importance of Process Control in Food Processing Industry.

    5

    (b) Explain the following performance parameters used for Measurement Systems.   10

    (i) SPAN

    (ii) SENSITIVITY

    (iii) LINEARITY

    (iv) PRECISION

    (v) ACCURACY { e 2% for 0-10kg/cm^2 }.

(c) What are the Dynamic characteristics of an Instrument ? Explain (i) FIDELITY (ii) BANDWIDTH. 3+2

2. (a) Explain the Functional Element of an Instrumentation measurement system with a suitable example. 10

(b) What are the points to be considered for selection of a transducer ? 5

(c) What are the various classification of Transducers ? 5

3. (a) (i) Explain the control valves characteristics and derive the relation of % Flow versus % opening for equal percentage valve.

(ii) Explain the phenomena of Cavitation and Flashing occurring in valves. 4+4+2

(b) Explain the different forms of Controller action (i) Proportional (ii) Proportional Integral and Derivative. Sketch the Response curves for STEP input for the Proportional, Integral, Derivative and Proportional Integral Derivative Controller. 6+4
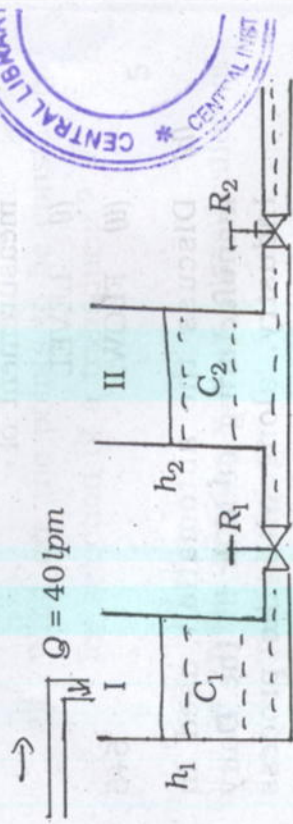
4. (a) Discuss *any two* methods for measurement of
   (i) LEVEL
   (ii) FLOW. 5+5

(b) Discuss the automation used in manufacturing of Milk in the Dairy Industry, along with the process description. 10

5. (a) What do the following descriptions mean in a P & I diagram ? 6
   (i) FIC
   (ii) FT
   (iii) TT
   (iv) TY
   (v) PSH
   (vi) LSL

(b) How is the location of an instrument interpreted in P & I diagram? Explain with a diagram. 4

(c) Obtain the complete transfer function relating the variables of the system for the process $\dfrac{h_2(s)}{Q(s)}$. 10

$Q = 40\,lpm$

$[h_1 = 2\cdot5m, h_2 = 2m, C_1 = 1\cdot5m^2, \therefore C_2 = 1\cdot2m^2]$

$Q = 40\,lpm$

Determine the Time constants of the two tanks.

6. (a) Elaborate the salient points of open-loop and closed-loop control system. 5

(b) Consider the unity feedback system having open-loop transfer function

$$G(s) = \frac{K(s+2)}{s^2\left(s^2 + 7s + 2\right)}$$

Determine :

(i) Type and order of system

(ii) Static Error Coefficients

(iii) Steady-State Error for Unit step, Unit ramp inputs.

2+3+5

(c) Comment on the stability of the system using Routh-Hurwitz stability criterion for the given characteristic equation,

$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16.$

Comment on the location of the roots of characteristic equation.

4+1

7. (a) Sketch the Root Locus of a unity feedback control system with open-loop transfer function

10

$$G(s) = \frac{K}{(s)(s+1)(s+3)}.$$

(b) Reduce the Block diagram and determine the transfer function $\frac{C(s)}{R(s)}$ of the system and verify with signal flow graph. 6+4