53 (IE 605) PRIC

2018

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 out of **seven**.*

1. *(a)* What are the Functional Elements of an instrument ? Explain it with suitable example. 11

   (b) Define the following terms — 9

   (i) Accuracy

   (ii) Precision

   (iii) Sensitivity

   (iv) Reproducibility

   (v) Drift

   (vi) Speed of response

(vii) Dead Zone

(viii) Fidelity

(ix) Hysteresis.

2. (a) Explain *any two* level measurement techniques for measurement of milk powder /wheat flour in the silos. 10

(b) What instrumentation is used in clean-in-place process so as to reduce waste and increase efficiency in the Dairy industry ? 10

3. (a) Explain the inherent characteristics of a control valve. 6

(b) Explain various modes of control action. Discuss its advantages and disadvantages. 10

(c) Write short note on I/P Converter. 4

4. (a) Draw a neat sketch of a distillation column and explain the various instrumentations used along with its symbolic representation. 10

(b) Explain the principle, construction and working of RTD, thermistor and thermocouple. 10

5. *(a)* Derive the transfer function $H(s) / Q(s)$ for the liquid-level system shown in *fig.* 1 when 10

(i) the Tank operates about the steady-state value of $hs = 0{\cdot}3m$.

(ii) the Tank operates about the steady-state value of $hs = 1m$.

The pump removes water at a constatnt rate of $0{\cdot}3m^3/min$, and is independent of head. The cross sectional area of the tank is $0{\cdot}1m^2$ and the resistance R is $11\ m^2/min$.

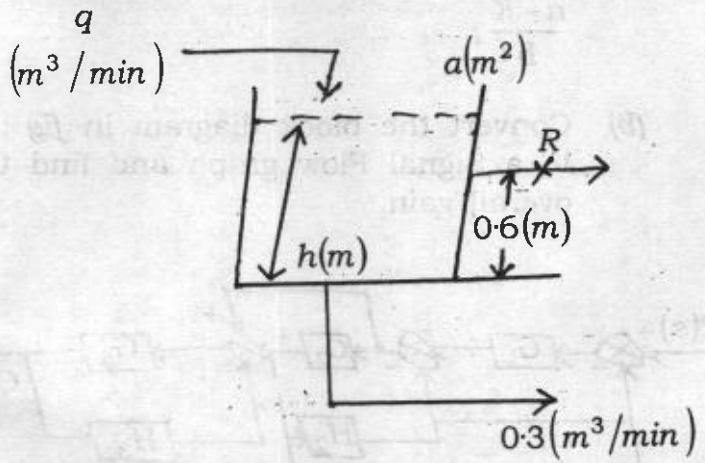

fig. 1

(b) A unity Feedback Control System has an open loop transfer function, $G(s)=20/(s+3)(s+4)$. Find the rise time, peak time, percentage over-shoot and settling time. 10

6. (a) Consider a unity Feedback System with a closed loop transfer function. 10

$$\frac{C(s)}{R(s)}=\frac{Ks+b}{s^2+as+b}$$

Determine the open loop transfer function $G(s)$. Show that steady-state error with unit ramp input is given by

$$\frac{a-K}{b}.$$

(b) Convert the block diagram in *fig* : 2 to a Signal Flow graph and find the overall gain. 10

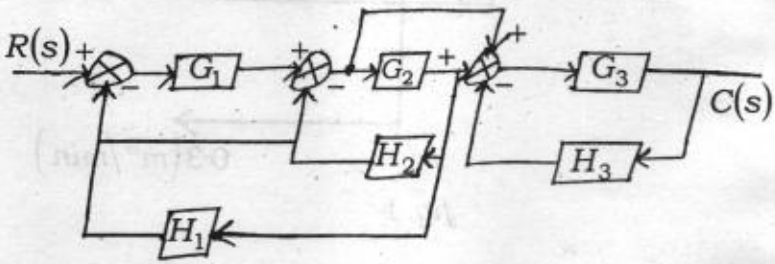

fig. 2

7. *(a)* Using routh criterion, determine the locations of the roots of the following characteristic equations and comment on the stability of the system. 10

(i) $2s^5 + 2s^4 + 5s^3 + 5s^2 + 3s + 5 = 0$

(ii) $3s^4 + 10s^3 + 5s^2 + 5s + 3 = 0$

(b) Draw or sketch the root locus for a unity Feedback Control System has an open loop transfer function, 10

$$G(s) = \frac{K}{s(s^2 + 4s + 13)}$$