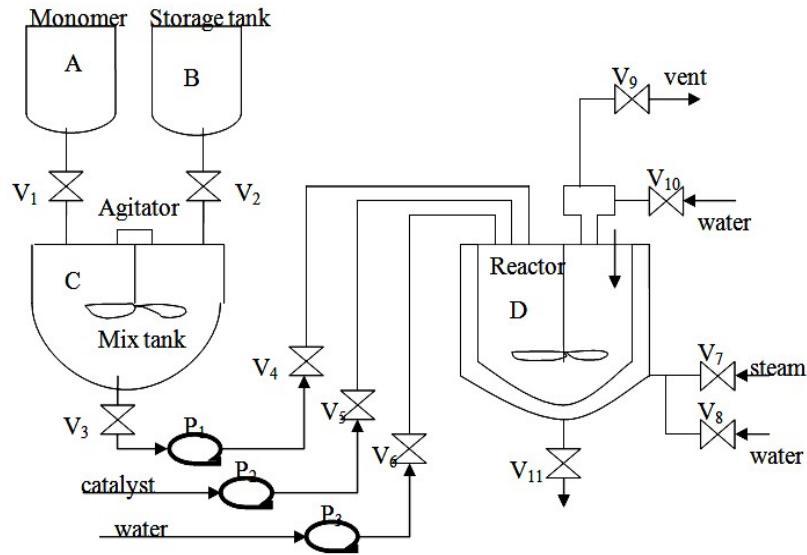


(b) Design a scheme for thickness measurement and control of a steel strip.
4 + 8 = 12

9.



In Fig. above, the components A and B are mixed in tank C. The mixture, catalyst and water in presence of some other components produce thermostat resin. Outline the control problem and show how by using the batch controller of Honeywell TDC3000 (or by any other make) distributed control system, the control problem is efficiently tackled.

12

PROCESS CONTROL SYSTEM DESIGN
(AEIE 5201)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group. Candidates are required to give answer in their own words as far as practicable.

Group - A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: 10 × 1 = 10
 - (i) The z-transform of a^k is

(a) $\frac{z}{z-a}$	(b) $\frac{z}{z-k}$	(c) $\frac{a}{z-a}$	(d) $\frac{a}{a-z}$
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 - (ii) The transition matrix Φ of a digraph is a

(a) unit matrix	(b) square matrix
(c) matrix of any dimension	(d) none of these.
 - (iii) First moment (m_1) of the response function $y(t)$ is

(a) $\int_0^t [1 - c(t)] dt$	(b) $\int_0^t [1 - y(t)] dt$
(c) $\int_0^t y(t) dt$	(d) $\frac{dy}{dt}$
 - (iv) In order to specify a process completely, the number of degrees of freedom should be

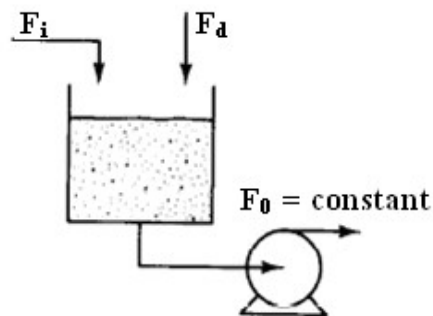
(a) zero	(b) infinity
(c) process specific	(d) none of them.
 - (v) The transfer function of a first order process with dead time of 4 second is given by

(a) $\frac{K_p}{\tau s + 1}$	(b) $\frac{K_p}{\tau s + 4}$	(c) $\frac{K_p e^{-4s}}{\tau s + 1}$	(d) $\frac{K_p e^{4s}}{\tau s + 1}$
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- (vi) In an open loop control system
 - (a) output is independent of control input
 - (b) output is dependent on control input
 - (c) only system parameters have effect on the control output
 - (d) never get the desired output.
- (vii) Flashing temperature (feed entry) in distillation column is
 - (a) more than bubble point
 - (b) intermediate between bubble point and dew point
 - (c) less than dew point
 - (d) independent of bubble point and dew point.
- (viii) In situations where noise is extensive, the data highway uses
 - (a) fiber optics
 - (b) twisted coax cables
 - (c) shielded coax cables
 - (d) none of these.
- (ix) The Laplace transfer function of a 2 second transportation lag element is
 - (a) $\frac{1}{(s+2)}$
 - (b) e^{2s}
 - (c) e^{-2s}
 - (d) $e^{-s/2}$.
- (x) If TF of a distillation column is $\frac{1.5e^{-25s}}{(25.5s+1)(38.2s+1)(3s+1)}$; then dead time is
 - (a) 25.5 sec.
 - (b) 25 sec.
 - (c) 38.2 sec.
 - (d) 3 sec.

Group - B

- 2. (a) Find the transfer function for a liquid level tank system as shown in the figure and analyse the step response of the system.



- (b) Draw and describe the operation of a shell and tube type heat exchanger unit.
- (4 + 3) + 5 = 12**

- 3. (a) Describe the six step method of empirical modelling of the system with suitable block diagram.
- (b) Explain the process reaction curve method for identifying dynamic model of a first-order-with dead-time system.

6 + 6 = 12

Group - C

- 4. (a) Describe the components of a Monolithic SCADA system with suitable block diagram.
 - (b) Describe the point-to-point HART network architecture.
- 8 + 4 = 12**
- 5. Write short notes (any three):
 - i. Master-slave communication protocol
 - ii. Reliability
 - iii. Redundancy
 - iv. Graphic display in DCS

(4 × 3) = 12

Group - D

- 6. (a) "Process parameter variations can be adjusted by Gain scheduling adaptive controller."- Justify the statement. State the advantages and drawbacks of Gain scheduling controller.
 - (b) Design an adaptive control scheme for a Phosphate Drying Furnace.
- (4 + 2) + 6 = 12**
- 7. (a) Establish a relation between probability and possibility theorem with example.
 - (b) Develop a fuzzification module for two input variables error and change of error. Where error $e(t) = \text{set-value } r(t) - \text{process value } y(t)$ and change of error $\Delta e(t) = e(t) - e(t-1)$.

4 + 8 = 12

Group - E

- 8. (a) An oven in open loop generates an output voltage of 1.93 volt for application of 0.84 volt at the input. Find out the system model, if the dead time and time constant of the oven is 270 secs. and 4000 secs. respectively.