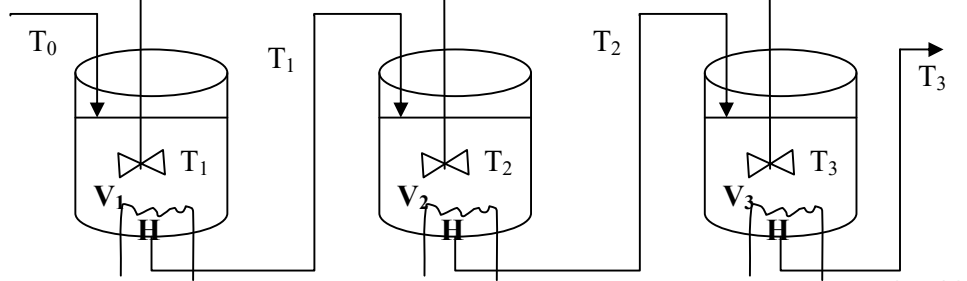


- (vi) Which of the following is used to calculate transfer function of a system?  
 (a) The order of the system (b) The time constant  
 (c) The output for any given input (d) The steady state gain.
- (vii) In electrical-pneumatic system analogy the current is considered analogous to  
 (a) velocity (b) pressure  
 (c) air flow (d) air flow rate.
- (viii) Dual control is a/an \_\_\_\_\_ control.  
 (a) adaptive (b) cascade  
 (c) batch (d) supervisory
- (ix) The truth values of traditional set theory is \_\_\_\_\_ and that of fuzzy set is \_\_\_\_\_  
 (a) Either 0 or 1, between 0 & 1 (b) Between 0 & 1, either 0 or 1  
 (c) Between 0 & 1, between 0 & 1 (d) Either 0 or 1, either 0 or 1
- (x) If transfer function 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.

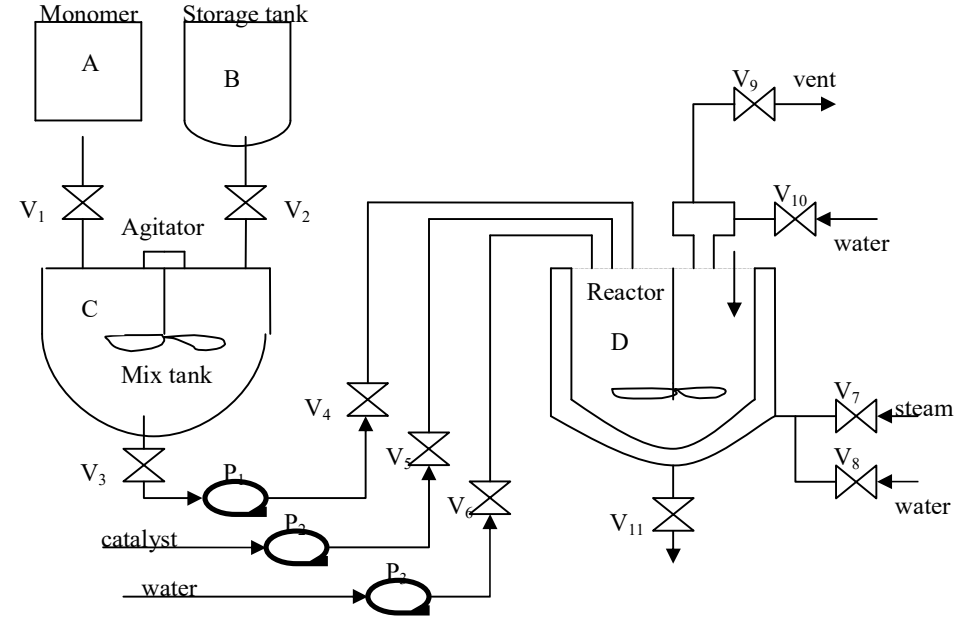
**Group - B**

2. (a) What is the necessity of process modelling?  
 (b) A series of 3 heat exchangers, where a liquid of density  $\rho$  and specific heat capacity of  $c_p$  is heated.  $T_0, T_1, T_2$  and  $T_3$  refer the temperature and  $V_1, V_2$  and  $V_3$  are respective volumes of the liquid in the heat exchangers. Find out the dynamic as well as steady state model of the system for a uniform volumetric flow rate of  $q$  and heat inputs of  $H$ .



4 + 8 = 12

9.



The component A and B is 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

M.TECH/AEIE/2<sup>ND</sup> SEM /AEIE 5201/2016  
2016

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 alternatives for the following: **10 × 1=10**

- (i) The z-transform of  $\frac{1}{s+a}$  is
- (a)  $\frac{z}{z - ae^{-aT}}$       (b)  $\frac{z}{z - e^{-aT}}$       (c)  $\frac{e^{aT}}{z - a}$       (d)  $\frac{az^{-aT}}{z - T}$ .
- (ii) Response of a system to a sinusoidal input is called \_\_\_\_\_ response  
(a) frequency      (b) impulse  
(c) unit step      (d) sinusoidal.
- (iii) A control system in which the control action is some how dependent on the output is known as  
(a) closed loop system      (b) multi loop system  
(c) open loop system      (d) semi closed loop system.
- (iv) In a control system the output of the controller is given to  
(a) final control element      (b) amplifier  
(c) comparator      (d) sensor.
- (v) A car is running at a constant speed of 50 km/h, which of the following is the feedback element for the driver?  
(a) Clutch      (b) Eyes  
(c) Needle of the speedometer      (d) Steering wheel

3. (a) What is meant by First moment of a response function C(t) ?  
 (b) The process transfer function of a third order system is given by:

$$G(s) = \frac{C(s)}{G(s)} = \frac{1}{(s+1)(0.5s+1)(2s+1)}$$

where the time constants are expressed in minutes. The true response of C(t) to a step change in input X(t) is shown in the following figure (Fig-A). Approximate this process by a second-order plus dead-time model.

Given that the first moment  $m_1$  is computed to be 3.5mins and the tangent line drawn at the point of inflection of the plot has a slope  $M_i = 0.23\text{min}^{-1}$ , and it intersects C(t)=1 line at  $t_m = 5.1\text{min}$ . Find  $\eta$  from Fig.B.

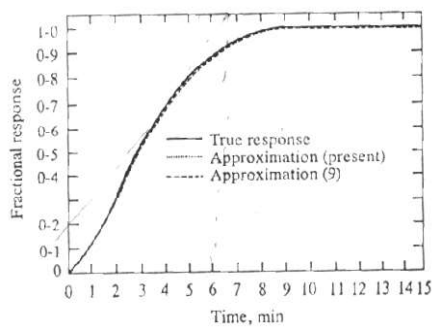


Fig. A

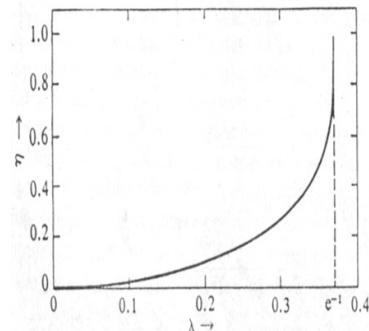
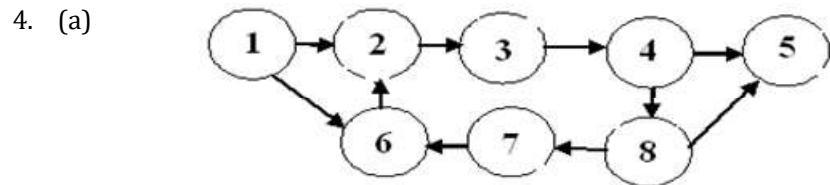


Fig. B

4 + 8 = 12

Group - C



Develop transition matrix and interconnection matrix for the above digraph.

- (b) What is data link configuration? Give example with configurations.  
 8 + 4 = 12

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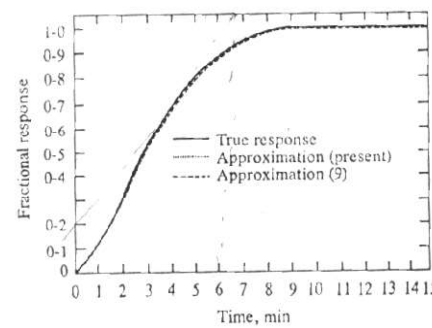


Fig. A

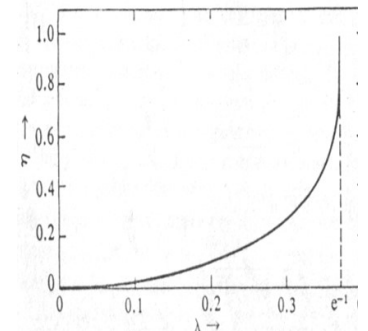
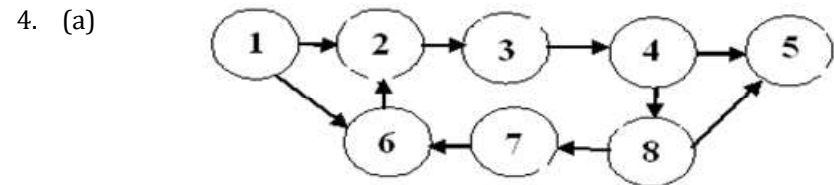


Fig. B

4 + 8 = 12

Group - C

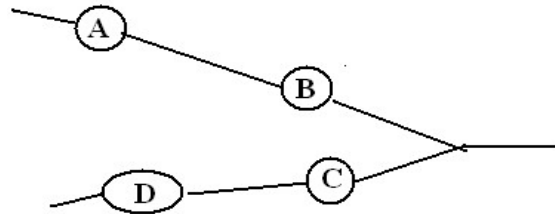


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**M.TECH/AEIE/2<sup>ND</sup> SEM /AEIE 5201/2016**

5. (a) Explain the steps of a typical multilayer control system with block diagram.
- (b) A water authority has four reservoirs namely A, B, C and D connected as shown below, from which it supplies customers. The authority has the possibility to make bulk purchases or bulk sales. The authority aims to steer the system from an initial state  $\mathbf{x}(t_0)$  at time  $t_0$  to a prescribed state  $\mathbf{x}(t_f)$  at time  $t_f$ . Outline an approach to solving the problem using multilayer optimization technique.



5 + 7 = 12

**Group - D**

6. (a) How influences of process parameter variations are reduced by gain scheduling adaptive scheme?
- (b) Design an adaptive control scheme for a Phosphate Drying Furnace.
7. (a) Why fuzzy logic is called knowledge based system?
- (b) What type of membership function is suitable to represent the hotness of a body or age of a people? – explain with example.
- (c) Design a  $\pi$  membership function and write an application where we can use this type of membership function.

2 + 5 + 5 = 12

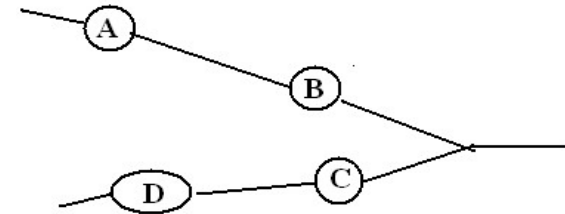
**Group - E**

8. (a) Illustrate a scheme to identify the model of an oven in open loop.
- (b) Draw an outline diagram to explain the temperature control of an electrical oven.
- (c) Design a scheme for flatness measurement and control of a steel strip.

4 + 4 + 4 = 12

**M.TECH/AEIE/2<sup>ND</sup> SEM /AEIE 5201/2016**

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