Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

INSPIRED BY LIFE

VI SEMESTER B.TECH (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 2016

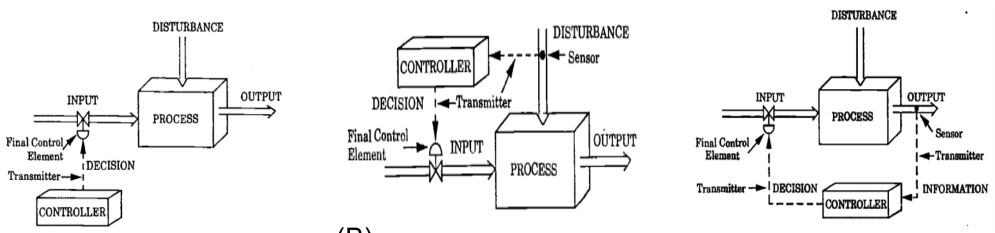
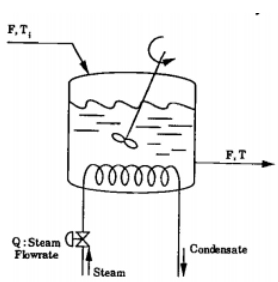
SUBJECT: PROCESS DYNAMICS AND CONTROL [CHE 308]

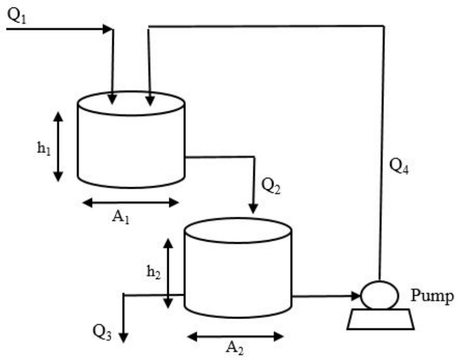
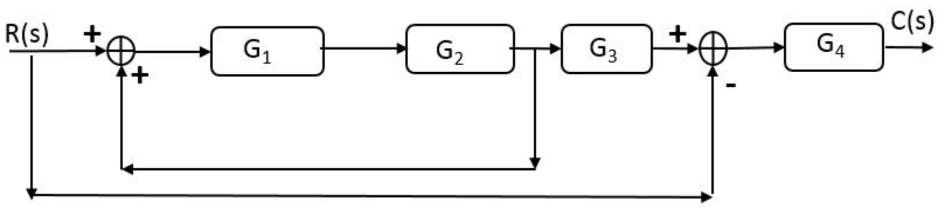
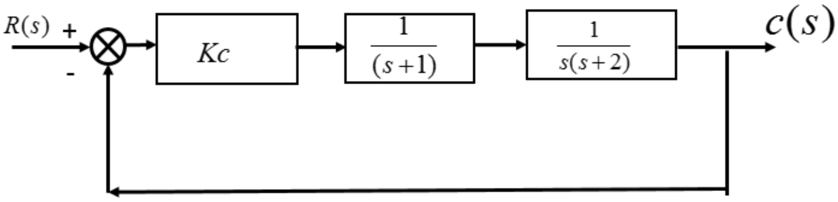
REVISED CREDIT SYSTEM

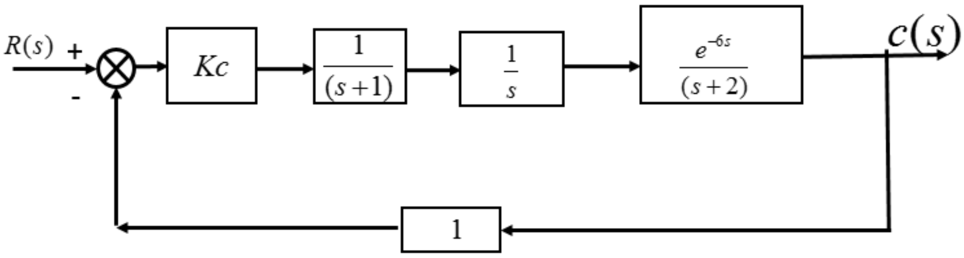
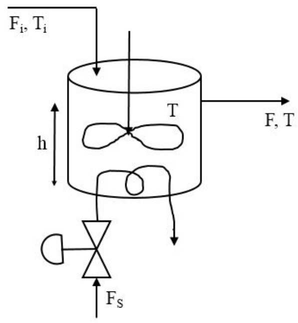
Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitably assumed.

1A	With a neat sketch explain the components of feedback control system. State roles of each component	08
1B	Identify the different control structures shown in figure 1B  (A) (B) (C) Figure: 1B	06
1C.	What is the fundamental difference between "First principle modeling” and "Black box modeling"?	06
2A	Describe the ideal forcing functions. Write their Laplace transform for each of the functions and how these ideal forcing functions might be implemented on real processes by considering the following example system (see Figure 2A), the stirred heating tank. Consider steam flow as input variable.  Figure: 2A	08

2B.	Why is the Laplace transform useful in developing Transfer function model by solving linear ODE's?	02
2C	Solve the following differential equations $$\frac{d^2T(t)}{dt^2}+5\frac{dT(t)}{dt}+6T(t)=f(t)$$ By the method of Laplace transforms given the following conditions, $f(t)=1; T(0)=1; T^I(0)=0$	10
3A	Explain the process of linearization. Linearize the temperature dependence of reaction rate constant is given as follows: $$K(T)=K_o e^{-E/RT}$$	06
3B	Develop a transfer function model (i.e., relates between h_2 and Q_1) for the problem given in Figure 3B. It is Assumed that flow-head relationship are linear for both the tanks and constant displacement pump is used to pump the liquid from tank-2 to tank-1.  Figure 3B	08
3C	Determine the overall transfer C(s)/R(s) for system shown in Figure 3C.  Figure: 3C	06
4A	Describe the Ziegler-Nichols tuning methodology. This procedure is often called the "continuous cycling" tuning method. Why?	08
4B	Sketch the root locus of the control system shown below.  Determine the value of gain of the controller for which the system is on the verge of unstable and corresponding roots.	12

5A	It is decided to design a PI controller for process which behaves as first order dynamics. The final control element and measuring elements are follows unity gain responses. Prove that offset doesn't exists with PI controller to control the above system.	06
5B	Determine the ultimate gain and ultimate period using frequency response method for the control system shown in Figure 5B.  Figure:5B	14
6A	Define the three time integral performance criteria to shape the closed loop response. What are the relative advantages and disadvantages of these criteria? How would you select the most appropriate for a particular application?	08
6B	Discuss the working principle of ratio control and auctioneering control scheme.	06
6C	Design a static feedforward controller for continuous stirred tank heater as shown below (see Figure 6C). The control objective is to keep the exit temperature (T) at desired value by regulating steam flow (i.e. Fs) for changes in an inlet temperature of the feed (T_i). Assume that level in the tank remain constant. State all the assumptions made.  Figure: 6C	06