Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

SEVENTH SEMESTER B.TECH (INSTRUMENTATION & CONTROL ENGG.)

END SEMESTER EXAMINATIONS, DEC 2016 / JAN 2017

SUBJECT: PROCESS INSTRUMENTATION AND CONTROL [ICE 401]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. Explain the design methodology of a process control system with suitable example. **4**

1B. Draw the feed forward with feedback control loop for a system and explain the working. **4**

1C. Write differences between theoretical and empirical models. **2**

2A. Consider the liquid-level system shown in Fig Q2A. At steady state, the inflow rate and outflow rate are both $\bar{Q}$ and the flow rate between the tanks is zero. The heads of tanks 1 and 2 are both $\bar{H}$ At t = 0, the inflow rate is changed from $\bar{Q}$ to $\bar{Q}+q$, where q is a small change in the inflow rate. The resulting changes in the heads (h_1 and h_2) and flow rates (q_1, and q_2) are assumed to be small. The capacitances of tanks 1 and 2 are C_1 and C_2, respectively. The resistance of the valve between the tanks is R_1, and that of the outflow valve is R_2. Derive mathematical models for the system when (a) q is the input and h_2 the output, (b) q is the input and q_2 the output. **5**

2B. Explain single speed floating control mode with necessary equations and graph. Suppose a process error lies within the neutral zone with $p=25\%$. At $t=0$, the error falls below the neutral zone. If K= +2% per second, find the time when the output saturates. **3**

2C. Explain batch process with an example. **2**

3A. A PID controller has KP = 2.0, KI = 2.2 s-1, KD = 2 s , and PI(0) = 40%. Plot the controller output for the error of Fig Q3A. **4**

3B. Using a system of opamps design a two position controller with a 0 to 10 V input and a 0 or 10 V output. The set point is 4.3 V and the neutral zone is to be + 1.1 V about this set point. **3**

3C. Derive the closed loop transfer function of the block diagram given in Fig Q3C and discuss the effect of offset for servo and regulatory control with necessary response plot. **3**

4A. A transient disturbance test is run on a process loop. The results of a 9 % controlling variable change give a process reaction graph as shown in Fig Q4A. Find settings for three mode action using Ziegler Nichols Method. **3**

4B. Discuss the different types of time integral performance criteria and the general guidelines for the selection. **3**

4C. Draw the schematic and block diagram of a cascade temperature-pressure control system in a closed kettle and derive the overall closed loop transfer function. Make necessary assumptions. **4**

5A. When do we implement inferential control? Explain with block diagram and an example. **3**

5B. With neat diagram explain the working of hydraulic actuators. **4**

5C. What are installed and inherent characteristics of a control valve? Explain with necessary graph. **3**

6A. Draw the skeleton of a control vale and mark its components. Also write a note on selection of control valves. **4**

6B. Write a note on control valve sizing. **2**

6C. Draw the architecture of direct digital control and explain. **4**

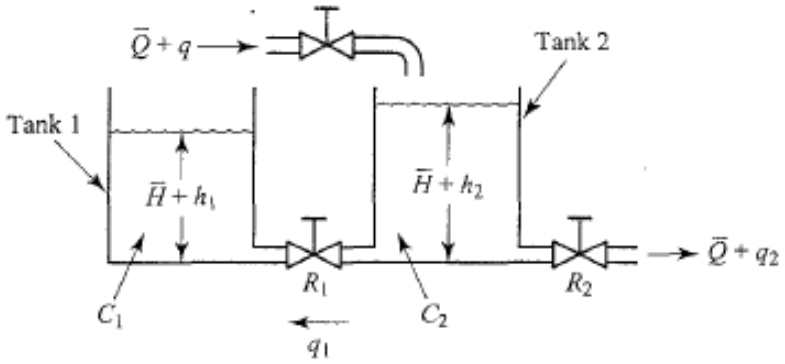

Fig Q2A

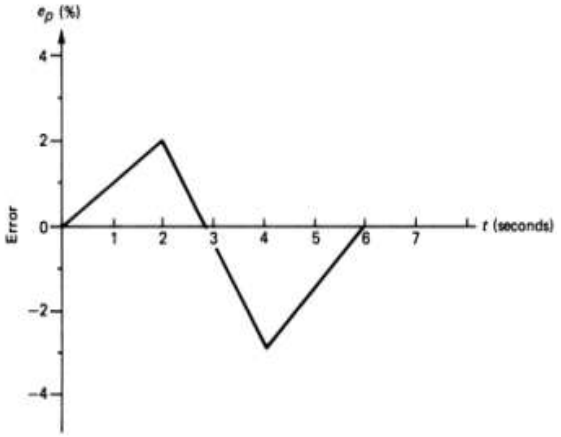

Fig Q3A

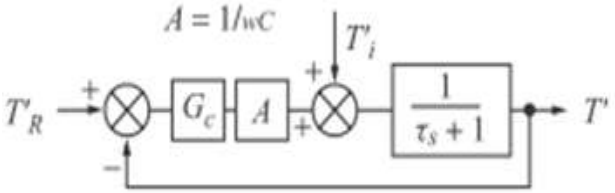

Fig Q3C

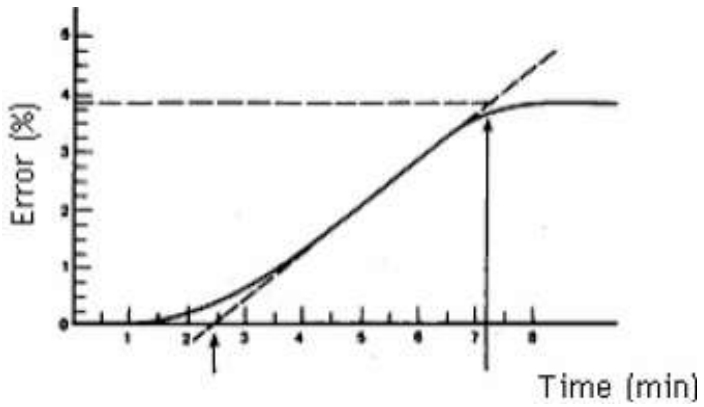

Fig Q4A