Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

SEVENTH SEMESTER B.TECH (INSTRUMENTATION AND CONTROL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: PROCESS INSTRUMENTATION AND CONTROL [ICE 401]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. Write a note on design methodology of process control systems. **3**

1B. What is multi-variable loop? Explain with necessary sketch. **2**

1C. Develop the mathematical model for the liquid level system making necessary assumptions. Also discuss about fluid capacitance and resistance. **5**

2A. Determine the transfer function H(s)/ Q(s) for the liquid-level system shown in Figure 2(a). Resistances R1 and R2 are linear. The flow rate from tank 3 is maintained constant at 'b' by means of a pump. **5**

2B. The temperature of water in a tank is controlled by a two-position controller. When the heater is *off* the temperature drops at 2 ^{0}K per minute. When the heater is *on* the temperature rises at 4 ^{0}K per minute. The setpoint is 323 K and the neutral zone is ±4% of the setpoint. There is a 0.5-min lag at both the *on* and *off* switch points. Find the period of oscillation and plot the water temperature versus time. **3**

2C. Write a note on floating control mode. **2**

3A. Suppose the error as shown in Figure 3(a), is applied to a proportional-derivative controller with K_P = 10, K_D = 0.7 s, and P_0 = 10%. Draw a graph of the resulting controller output. **4**

3B. Explain Ziegler Nichols open and closed loop tuning method with necessary equations. **4**

3C. Level measurement in a sump tank is provided by a transducer scaled as 0.5 V/m. A pump is to be turned on by application of +10V when the sump level exceeds 3.0 m. The pump is to be turned back off when the sump level drops to 2 m. Develop a two-position controller. **2**

4A. A temperature-control system inputs the controlled variable as a range from 0 to 4 V. The output is a heater requiring 0 to 8 V. A PID is to be used with, K_P = 2.4 %/%, K_I = 9% /(%–min), K_D = 0.7% /(%/min). The period of the fastest expected signal change is 8 s. Implement this controller with an op amp circuit. **7**

4B. Draw the sketch of a pneumatic proportional controller and explain its working. **3**

5A. What do you understand from time-integral performance criteria? Explain the types and compare the performance of each type with a graph. **3**

5B. How the dead time can be compensated using smith predictor? Explain. **3**

5C. With necessary figures and equations explain Internal Model Controller. **4**

6A. A control valve regulates the liquid flow of a tank. The water level is controlled in the tank at a level of 25 feet by regulating the outflow. The measured inflow varies from 0 to 120 gallons per minute. Calculate Cv for the valve. (1 foot of water develops a pressure of 0.433 psi). **2**

6B. Draw the figure of control valve and explain cavitation and flashing. **5**

6C. With neat diagram explain the architecture of a Digital Direct Control. **3**

Figures:

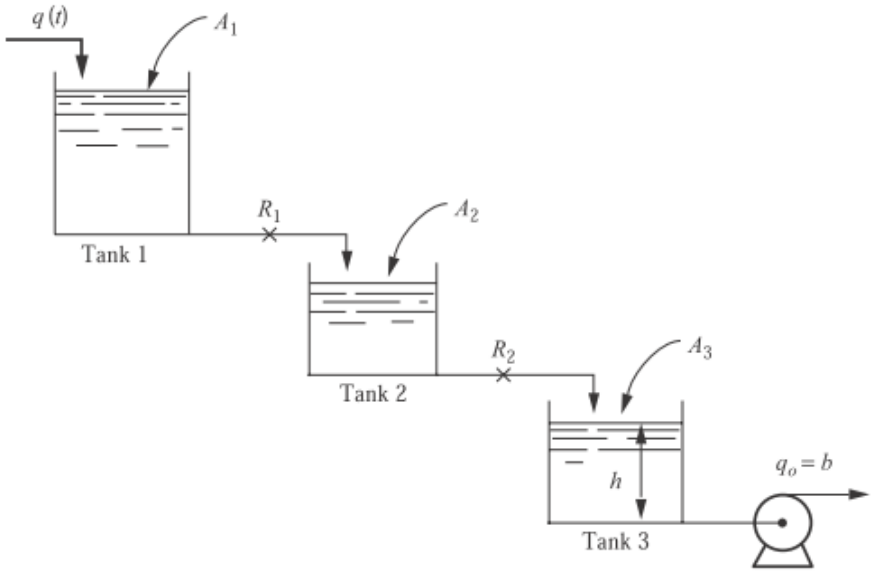

Figure 2(a)

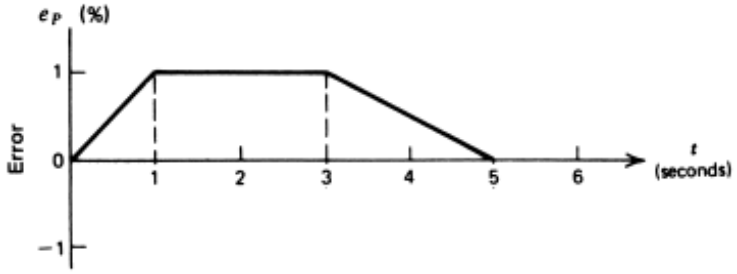

Figure 3(a)