Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

FIFTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)

END SEMESTER EXAMINATIONS, NOV - 2017

SUBJECT: PROCESS INSTRUMENTATION AND CONTROL [ICE 3106]

Duration: 3 Hour | Max. Marks:50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A Determine the transfer function H(s)/ Q(s) for the liquid-level system as shown in Fig.Q1A. Resistances R_1 and R_2 are linear. The flow rate from tank 3 is maintained constant at 'b' by means of a pump. 5

1B Consider a thin, glass walled mercury thermometer system as shown in Fig.Q1B. Assume that the thermometer is at a uniform temperature θ°C (ambient temperature). At t = 0, it is immersed in a bath of temperature θ+ θ_b°C, where θ_b is the bath temperature (which may be constant or varying), measured from the ambient temperature θ.The instantaneous thermometer temperature is changed by θ+θ_t°C, so that θ_t is the change in the temperature of the thermometer, satisfying the condition that θ(0) = 0. Obtain the Mathematical model of the system. 3

1C Draw and label the schematic of a Continuous Stirred Tank Reactor with two feedback loops, used for simultaneous control of temperature of the fluid inside and volume of fluid inside the tank. 2

2A Suppose the error in Fig.Q2A, is applied to a proportional-derivative controller with K_P = 5, K_D = 0.5 s, and P_o=20%. Draw the graph of the resulting controller output. P. 4

2B Using suitable equations, explain the effect of proportional control on the step response of a first order process for servo problem and get the value of offset. Consider unity transfer function for sensor and final control element. 4

2C What is the effect of increasing the proportional gain of a PID Controller with regard to the following criteria in a closed loop system: 2
(i) Peak Overshoot
(ii)Settling time
(iii)Steady state error

3A A type-J TC with a 0°C reference is used in a proportional-mode temperature control system with a 140°C set point and a range of 100-180°C. The zero-error output should be 45%, and the PB=35%. The output is 0–10 V, and the full scale input range is 0 to 1 V. Design an analog electronic controller. 5

3B	Using a neat schematic, explain the working of pneumatic proportional controller.	3
3C	Distinguish between ISE and IASE with regard to controller performance evaluation criteria.	2
4A	Explain the Ziegler Nichols closed loop method for controller tuning and write the parameters for different controller modes. How does it differ from damped oscillation method?	5
4B	With equations, describe the working and design of a dead time compensator.	3
4C	Discuss the stability requirement criteria for controller tuning using frequency response method.	2
5A	Draw the block diagram and derive the closed loop response of a feedforward-feedback controller. Draw the schematic of the FF-FB controller loop for a stirred tank reactor with objective to maintain the temperature and volume.	5
5B	Using an appropriate example explain about split range control.	3
5C	How does a Model Reference Adaptive controller differs form a self-tuning regulator?	2

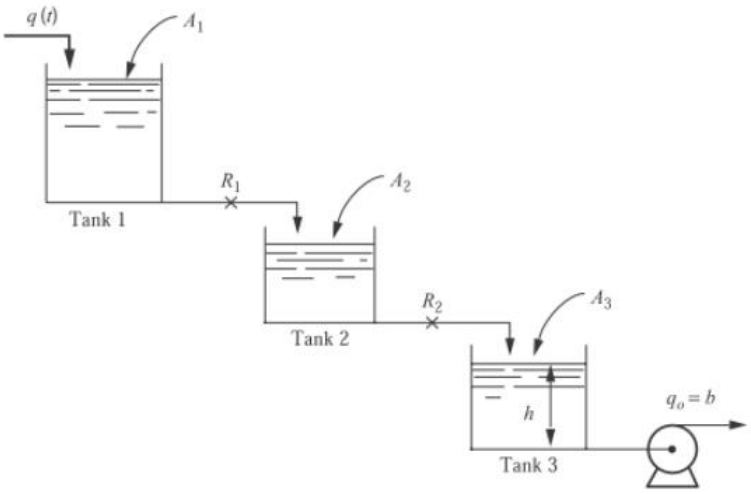

Fig.Q1A

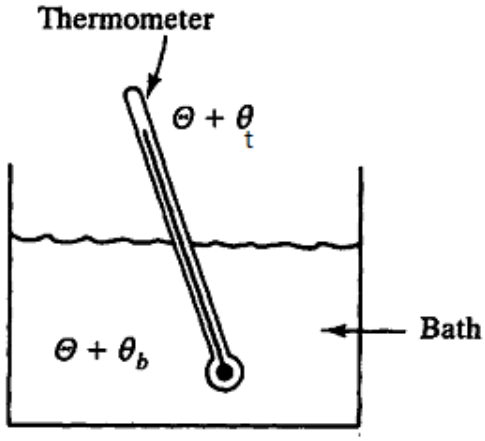

Fig.Q1B

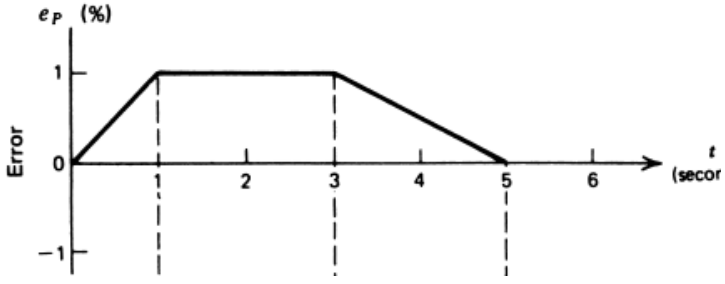

Fig.Q2A