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/DEC 2016

SUBJECT: PROCESS INSTRUMENTATION AND CONTROL [ICE 3106]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:
- Answer **ALL** the questions.
- Missing data may be suitably assumed.

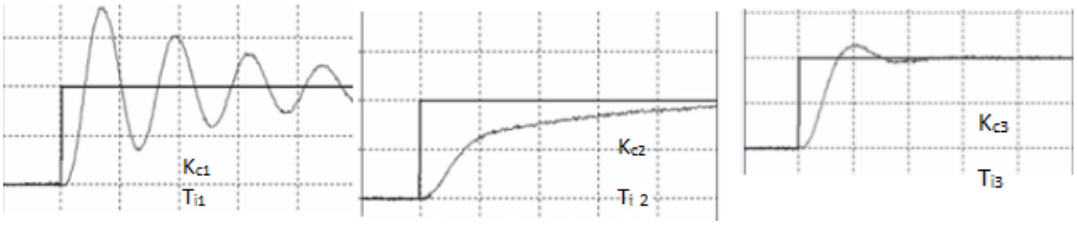
1A. Consider the liquid-level system shown in Fig.Q.1A. Obtain the transfer function for the system when q is the input and h_2 is the output. **5**

1B. Considering small deviations from steady-state operation, write the differential equations and draw a block diagram of the air heating system shown in Fig.Q.1B. Assume that the heat loss to the surroundings and the heat capacitance of the metal parts of the heater are negligible. **3**

1C. Draw the block diagram and explain the implementation of a closed loop control system to continually monitor and control the temperature or dryness of the clothes in a cloth dryer. **2**

2A. A PID controller has K_p=2.0.K_i=2.2sec^{-1},K_d=2s and $P_I(0)$=40%. Plot the controller output for the error shown in Fig.Q.2A

2B. **3**



(i) (ii) (iii)

Graphs above shows the response of a process controlled by a PI controller with different values of K_c and T_i.Giving reason, arrange corresponding K_c and T_i in increasing order.

2C Using a suitable example, discuss the effect of reset windup on controllers. **2**

3A. Design a PID temperature control system which inputs error in 0-4V range. The output to final control element is 0-8V. Given, K_p=4.4%per%, K_i=14%/(%-min),K_d=1.7%/(%/min). **5**

3B. A sensor converts from 0 to 2.0m into a 4 to 20 mA current. Design an OpAmp based error detector for the set point 0.85m. **3**

3C. Fig.Q.3C shows a pneumatic controller. Identify the controller and explain its action. **2**

4A. Explain the procedure of process reaction method for controller tuning. Write the controller formulae of P, PI and PID controllers using this method. **5**

4B. What is quarter decay ratio with respect to controller performance evaluation criteria. What are its disadvantages? **3**

4C. Identify the process in Fig.Q.4C and draw a cascade control loop for the system. **2**

5A. The output equation of an uncontrolled process is given as: **5**

$y(s)=G_p(s)m(s)+G_d(s)d(s)$,

where y(s)=output,$G_p(s)$=Process transfer function,$G_d(s)$=Disturbance transfer funcation,d(s)=Disturbance.

Design a feedforward controller for the above process considering the transfer functions of the measuring device and the final control element.

5B. Using a suitable example describe scheduled adaptive controllers. **3**

5C. Design a split range control for a process where the pH value of process liquid is brought closer to neutral by the addition of either acid or caustic reagent liquids and explain its working. (Use air to open and air to close valve for acid and base inlet streams based on requirement). **2**

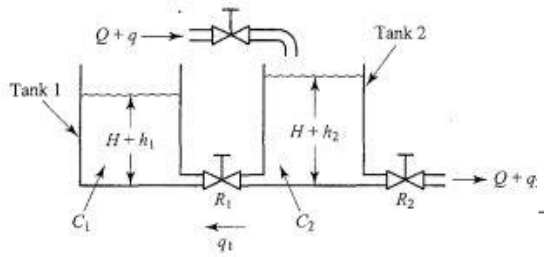


Fig.Q.1A

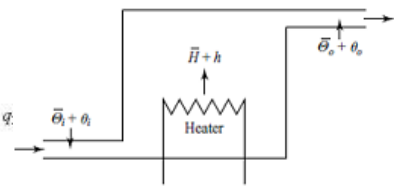


Fig.Q.1B

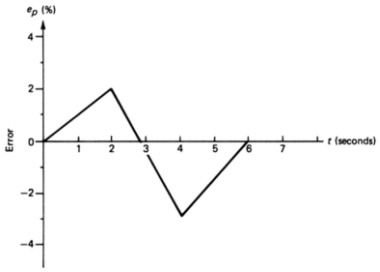


Fig.Q.2A

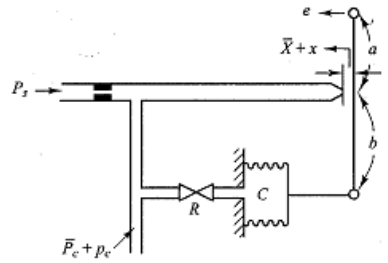


Fig.Q.3C

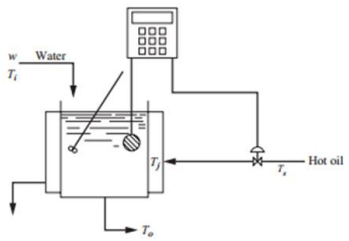


Fig.Q.4C

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