Code No: RR311004 **Set No.1**

III B.Tech. I Semester Supplementary Examinations, April/May -2005
PROCESS CONTROL INSTRUMENTATION
(Common to Electronics & Instrumentation Engineering and Instrumentation & Control Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What are the different types of process variables?
   (b) Name all the variables of a liquid heating tank heated by electric current in an electric heater.
   (c) Define "Degrees of freedom" and bring out its importance in process control.
2. (a) Differentiate between a "Servo operation" and "Regulator operation".
   (b) Give a typical example for servo operation and explain.
   (c) Explain the regulator operation with an example.
3. (a) Explain with a neat sketch depicting the error vs controller output, the principle of a proportional controller action.
   (b) With an example, explain how offset error in proportional controller occurs. Suggest a way to overcome the offset error.
4. (a) Explain in detail, the realization of proportional-integral action with the aid of bellows, flapper-nozzle etc.
   (b) Draw a three mode electronic controller and derive the expression for the output voltage.
5. (a) What is meant by process tuning and list the various methods of tuning of PID parameters.
   (b) Discuss process reaction method for control loop tuning.
6. (a) Explain how a DC motor can be used as an actuator for a final control operation.
   (b) What force is generated by 90 kPa acting on a $30cm^2$ area diaphragms.
7. A heating furnace requires a control valve passing 10gpm preheated light fuel oil (SP.gr. = 0.8) at full load and only 2 gpm at the smallest heating load. The source pressure constant at 50psi gage, but there is 10psi drop in the oil pre heater and 20 psi drop at the furnace burner nozzles. Remaining pressure drop occurs only at control valve when it is fully opened.
   (a) Find out control valve size required for the above application.
   (b) Find out required rangeability of the valve
   (c) Find out characteristic coefficient (α)

8. Discuss the design techniques related to multiple input and multiple output (MIMO) control system?

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Code No: RR311004 **Set No.2**

III B.Tech. I Semester Supplementary Examinations, April/May -2005
PROCESS CONTROL INSTRUMENTATION
(Common to Electronics & Instrumentation Engineering and Instrumentation & Control Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. A pressure vessel connected as shown below figure1 has a supply pressure u_1 of 45 psig, a vessel pressure of 15 psig, and an air to atmosphere. The average flow rate is 1 pounds per minute and the vessel volume is 0.3 cubic metre.

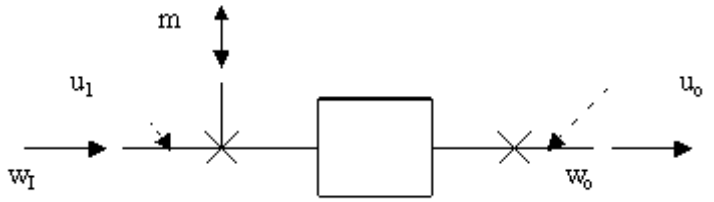

Figure 1:

   (a) Calculate the time constant.
   (b) Derive and calculate the system function.

2. Three identical tanks are operated in series in non-interacting fashion. For each tank, R=1 and t = 1. If the deviation in flow rate to the first tank is an impulse function of magnitude 2, determine
   (a) An expression for H(S) where H is the deviation in level in the third tank.
   (b) Obtain the expression for H(t).
   (c) Sketch the response H(t).

3. (a) Explain with a neat sketch depicting the error vs controller output, the principle of a proportional controller action.
   (b) With an example, explain how offset error in proportional controller occurs. Suggest a way to overcome the offset error.

4. (a) Briefly explain the principle of operation of a displacement type pneumatic PD controller. How the derivative time can be adjusted in this controller.
   (b) Outline the design steps involved in developing an electronic PI controller.

5. (a) Explain the following terms as applicable to system evaluation with necessary graphs.

i. Stability

ii. measure of quality .

(b) Discuss the quarter - amplitude criterion to evaluate the response.

6. (a) Explain how a DC motor can be used as an actuator for a final control operation.

(b) What force is generated by 90 kPa acting on a 30cm^2 area diaphragms.

7. Write short notes on.

(a) Sliding stem Valves

(b) Rotating shaft Valves

8. (a) Explain the closed loop characterization of cascade control system.

(b) Explain the primary and secondary loop gain adjustment in a cascade control system.

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Code No: RR311004 **Set No.3**

III B.Tech. I Semester Supplementary Examinations, April/May -2005
PROCESS CONTROL INSTRUMENTATION
(Common to Electronics & Instrumentation Engineering and Instrumentation & Control Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What are single capacity systems? Give one example and explain why it is called so?
   (b) Write the differential equation of this system and determine the transfer function.
   (c) Study the response of this pure capacity system to a step change in input.
2. (a) Say whether heated tank and an immersed thermometer with negligible interaction is interacting or non-interacting. Justify your answer.
   (b) Write the differential equations and determine the transfer functions individually for heated tank and thermometer.
   (c) Determine the overall transfer function of this combination. How is this transfer function related with the individual transfer function?
3. (a) Discuss the effects of an integral controller on the closed loop response of first order process.
   (b) With neat sketches, explain the principle of derivative control action. Summarize its characteristics.
4. (a) Explain in detail, the realization of proportional-integral action with the aid of bellows, flapper-nozzle etc.
   (b) Draw a three mode electronic controller and derive the expression for the output voltage.
5. (a) What is meant by process tuning and list the various methods of tuning of PID parameters.
   (b) Discuss process reaction method for control loop tuning.
6. (a) What is the importance of ac motor and briefly explain its principle.
   (b) Differentiate between ac motor and dc motor.
   (c) A stepper motor has 7.5^0 per step. Find the rpm produced by a pulse rate of 2000 pps on the input.
7. A heating furnace requires a control valve passing 10gpm preheated light fuel oil (SP.gr. = 0.8) at full load and only 2 gpm at the smallest heating load. The source pressure constant at 50psi gage, but there is 10psi drop in the oil pre heater and 20 psi drop at the furnace burner nozzles. Remaining pressure drop occurs only at control valve when it is fully opened.

(a) Find out control valve size required for the above application.

(b) Find out required rangeability of the valve

(c) Find out characteristic coefficient (α)

8. (a) Explain the closed loop characterization of cascade control system.

(b) Explain the primary and secondary loop gain adjustment in a cascade control system.

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Code No: RR311004 **Set No.4**

III B.Tech. I Semester Supplementary Examinations, April/May -2005
PROCESS CONTROL INSTRUMENTATION
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) List out atleast four important process variables that are controlled in industries.
   (b) Select simple processes for all these variables and write the mass balance equations for these systems.
2. (a) Give one example for non-interacting first order elements in series.
   (b) Write the differential equation for this combination and determine the transfer function.
   (c) Comment on the transfer function.
3. (a) Discuss relative advantages and disadvantages of the proportional, integral and derivative control actions.
   (b) Discuss the characteristic effects of a proportional controller on the closed loop response of a process.
4. (a) Explain in detail, the realization of proportional-integral action with the aid of bellows, flapper-nozzle etc.
   (b) Draw a three mode electronic controller and derive the expression for the output voltage.
5. (a) A proportional - integral controller is used on a pure time - delay process. Calculate the response to a step change in load if the controller gain is half the maximum value and the reset time is half the time delay. Calculate the integral of the absolute error.
   (b) Suggest and explain the control schemes for better control of process with dead time.
6. Explain the principle of a direct and reverse pneumatic actuator.
7. A heating furnace requires a control valve passing 10gpm preheated light fuel oil (SP.gr. = 0.8) at full load and only 2 gpm at the smallest heating load. The source pressure constant at 50psi gage, but there is 10psi drop in the oil pre heater and 20 psi drop at the furnace burner nozzles. Remaining pressure drop occurs only at control valve when it is fully opened.
   (a) Find out control valve size required for the above application.
   (b) Find out required rangeability of the valve

(c) Find out characteristic coefficient (α)

8. (a) Explain the closed loop characterization of cascade control system.

(b) Explain the primary and secondary loop gain adjustment in a cascade control system.

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