

BITS PILANI , DUBAI CAMPUS
Dubai International Academic City, Dubai, UAE
Semester II 2011-2012
COMPREHENSIVE EXAMINATION (Closed Book)
BE (Hons) III year EIE

Course No : INSTR C312
Course Title : INDUSTRIAL INSTRUMENTATION & CONTROL
Date : 07.06.12 Time: 3Hours M.M = 80 (40%)

NOTE: 1. All the symbols and words carry their usual meanings, unless otherwise stated.
2. Total No of Pages.2, No of Questions. 8

1A. An integral controller is used for temperature control in a range of 0 to 250°C with a set point of 150°C. At zero error, the controller output is 20%. Reset rate is -0.1% /sec per %error. If the temperature jumps to 180°C, calculate the controller output after 5 seconds.

1B. For a unity feedback system, process transfer function is given by $G_p(s) = \frac{1}{s(s+1)(s+5)}$.

The controller is of PID mode. Calculate the optimal values of controller parameter based on ultimate cycle method of tuning.

1C. Draw the response of P, PI & PID controllers for step input. [2+5+3M]

2A. Explain the different types of tuning methods with respect to errors for conventional controllers.

2B. Mention the basic components of direct digital control.

2C. What is adaptive control? Explain the types of it. [3+2+5M]

3A. Give the comparison for the below properties for (1) Feed forward control (2) Feedback control

Design measured variable, action & typical controller.

3B. When the cascade control will be ineffective?

3C. For a heat exchanger shown in figure(1), draw the schematic diagram for a combined feed forward and feedback controller in which inlet feed temperature is the major load variable and outlet temperature is the controlled variable. The combined controller output is the set point for steam pressure controller.

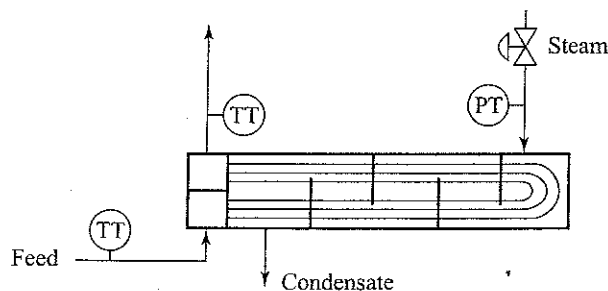


FIGURE 1. HEAT EXCHANGER

4. Draw a hierarchical DCS structure and explain function of each level. What are the important features of DCS?

[10 M]

5A. What is the disadvantage of double seated valve?

5B. Which valve will provide optimal control?

5C. Which valve has got the elastomer?

5D. What is the type of the valve or port which will give the quick opening characteristics?

5E. How Louvers valve is different from butterfly valve?

[2+2+2+2+2M]

6A. Using Hebb rule, train the OR Gate to the neural network. Try the maximum possible ways and indicate your comments. The order for training is

| X_1 | X_2 |
|-------|-------|
| 1 | 1 |
| 1 | 0 |
| 0 | 1 |
| 0 | 0 |

6B. Explain about artificial neuron structure.

[7.5+2.5M]

7A. Find the maximum-minimum, maximum-product and relational joint of A & B

$$A = \begin{bmatrix} 1.0 & 0.0 & 0.7 \\ 0.3 & 0.2 & 0.0 \\ 0.0 & 0.5 & 1.0 \end{bmatrix} \quad B = \begin{bmatrix} 0.6 & 0.6 & 0.0 \\ 0.0 & 0.6 & 0.1 \\ 0.0 & 0.1 & 0.0 \end{bmatrix}$$

7B. Find the Truthness of each proportion given.

The Ranges are: Age 15 to 45 Years, Weight 30 to 50 Kg, Height 4 to 6 Feet

The crisp data's are Age = 30 Years, Height = 5 feet, Weight = 35 Kg

1. You are young or Normal and tall is very true.

2. You are tall and average or old is fairly true

[6+4M]

8. Draw the RLD and LLD to sequentially energize solenoid A, B, C & D with the time delay of 10 sec's each other. Use data manipulation instruction.

[10 M]

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BITS, PILANI – DUBAI
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Semester II 2011-2012
TEST II / (Open Book)
BE (Hons) III year EIE

Course No : INSTR C312

Course Title : INDUSTRIAL INSTRUMENTATION & CONTROL

Date : 26.03.2012

Time: 50 Minutes

M.M = 20 (20%)

NOTE: 1. All the symbols and words carry their usual meanings, unless otherwise stated.
2. Answer all the questions.

1. Two liquid streams with flow rates F_1 and F_2 and temperatures T_1 and T_2 flow through two separate pipes which converge at a mixing junction as shown in Fig 1. We want to maintain the constant flow rate F_3 and the temperature T_3 of the liquid stream resulting from the mixing of the first two streams.

Identify;

[7 M]

- (a) What are the control objectives?
- (b) Develop a control system that uses only feedback controllers.
- (c) Develop a control system that uses only feed forward controllers.
- (d) Develop the control systems that use both feedback and feed forward controllers

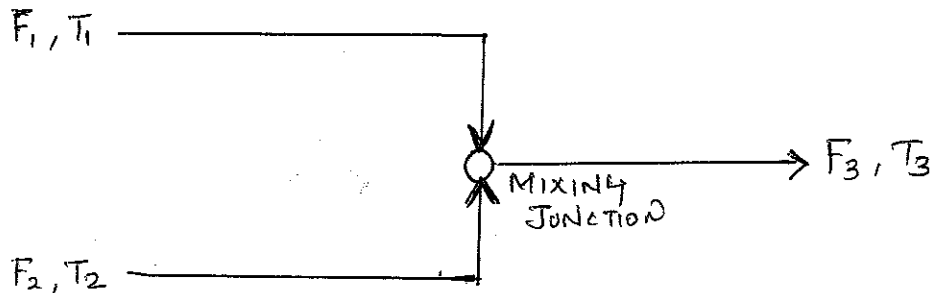


FIGURE 1

2. Using Hebb rule, train the OR Gate to the neural network. Try the maximum possible ways and indicate your comments. The order for training is

| X_1 | X_2 |
|-------|-------|
| 1 | 1 |
| 1 | 0 |
| 0 | 1 |
| 0 | 0 |

[7.5M]

PTO

3. Find the membership degree for a, b, c for height and age combination of (3.1666ft, 60 years), (5.4166ft, 30 years), (5.7499 ft , 27 years),(5.8333ft, 32 years) and (6.0833ft, 31years), where

a= x is tall and x is old

b= x is tall or x is old

c= not (x is tall).

Below is the membership function defined for tallness and old-age.

$$\mu_{\text{tall}}(x) = \begin{cases} 0 & \text{if height } (x) < 5 \text{ ft} \\ \frac{\text{height}(x) - 5 \text{ ft}}{2} & \text{if } 5 \text{ ft} \leq \text{height}(x) \leq 7 \text{ ft} \\ 1 & \text{if height } (x) > 7 \text{ ft} \end{cases}$$

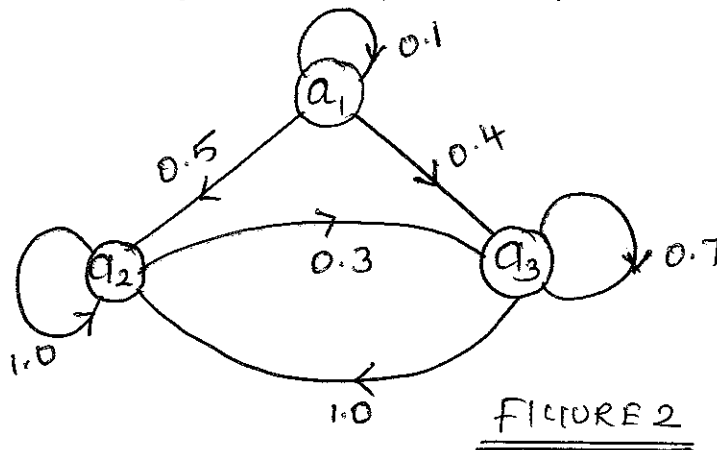
$$\mu_{\text{old}}(x) = \begin{cases} 0 & \text{if age } (x) < 18 \text{ years} \\ \frac{\text{age}(x) - 18}{42} & \text{if } 18 \leq \text{age}(x) \leq 60 \\ 1 & \text{if age } (x) > 60 \end{cases}$$

Draw a table and mention the values of height, age, x is tall, x is old, a, b & c.

[7.5 M]

4. For the network shown in Figure 2, write the expression for fuzzy relation R.

[3 M]



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Semester II 2011-2012
TEST I / (Closed Book)
BE (Hons) III year EIE

Course No : INSTR C312
Course Title : INDUSTRIAL INSTRUMENTATION & CONTROL
Date : 11.03.2012 Time: 50 Minutes M.M = 25 (25%)

NOTE: 1. All the symbols and words carry their usual meanings, unless otherwise stated.
2. Answer all the questions.

1. Design a PLC program for a typical Input / Output connection for the following counter Specifications;

- a. Counter counts the no of times when a push button is closed.
- b. Decrements the accumulated value of counter each time when a second push button is closed.
- c. Turn on light anytime when the accumulated value of the counter is less than 20.
- d. Turn on the second light when the accumulated value of the counter is equal to or greater than equal to 20.
- e. Reset the counter to zero when a selector switch is closed.

[6 M]

2. Design a PLC program for the following requirements.

The application requires an alarm to sound when a supply system leaks 5 lb or more of raw material in to the vessel after a preset weight of 500 lb has been reached. When the start push button is pressed the filling solenoid and filling indicating light are turned on and raw material is allowed to flow in to the vessel. When the weight reached 500 lb the filling solenoid is deenergized and the flow is cutoff. At the same time, the filling pilot light is turned off and fill pilot light indicator is turned on. If the filling solenoid leaks 5 lb or more of raw material in to the vessel, the alarm will energize and stay energize until the over flow level is reduced below 5 lb over flow limit. (Make use of Subtraction instruction).

[7 M]

3. Draw a table and compare the below mentioned parameters for the P, I, D controllers.

Rise time, Overshoot, Settling time, Steady state error.

[6 M]

4. An integral controller is used for speed control with a set point of 12 rpm with in a range of 10 to 15 rpm. The controller output is 22% initially. The constant $K_I = -0.15\%$ controller output per second per percentage error. If the speed jumps to 13.5rpm, calculate the rate of controller output change & controller output after 2 sec's for a constant e_p .

[3 M]

5. Draw the RLD & LLD to sound the horn with the help of LS1 and LS2 or LS3 and LS4.

[3 M]

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BITS, PILANI – DUBAI
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Semester II 2011-2012
QUIZ II / (Closed Book)
BE (Hons) III year EIE

Course No : INSTR C312

Course Title : INDUSTRIAL INSTRUMENTATION & CONTROL

Date : 22.05.2012

Time: 20 Minutes

M.M = 14 (7%)

NOTE: 1. All the symbols and words carry their usual meanings, unless otherwise stated.
2. Answer all the questions.

1. What are the main functions of the control valve? [2M]

2. Define rangeability. [1.5M]

3. Give the comparison for the below properties for (1) Feed forward control (2) Feedback control
Design principle & controller system configuration [2.5M]

4. Is ratio control is a type of feed forward control. Justify your answer.[2M]

5. The membership of fuzzy relation R "y is much greater than x" is defined as:

$$\mu_R(x,y) = \begin{cases} \frac{y-x}{x+y+2} & \text{if } y > x \\ 0 & \text{if } y \leq x \end{cases}$$

If $x = \{1, 2, 3\}$ and $y = \{1, 2, 3, 4, 5, 6\}$, express the fuzzy relation R as matrix.[3.5M]

6. What are the types of architecture in neural networks? [1.5M]

7. Classify the neural network on the basis of learning.[1M]

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Name:

ID No:

BITS, PILANI – DUBAI
Dubai International Academic City, Dubai, UAE
Semester II 2011-2012
QUIZ I / (Closed Book)
BE (Hons) III year EIE

Course No : INSTR C312

Course Title : INDUSTRIAL INSTRUMENTATION & CONTROL

Date : 03.04.2012

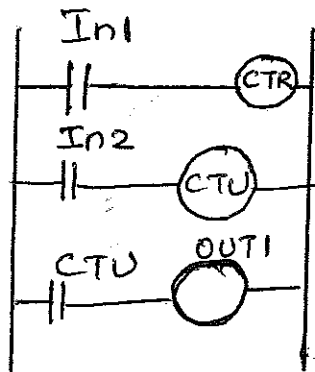
Time: 20 Minutes

M.M = 16 (8%)

NOTE: 1. All the symbols and words carry their usual meanings, unless otherwise stated.
2. Answer all the questions.

1. Decide whether each of these statements is True (T) or False (F).

For the ladder diagram shown in Figure (1), when the counter is set to 5, there is an output from out 1 every time:



(i) In 1 has closed 5 times.

(ii) In 2 has closed 5 times.

- a. (i) T (ii) T
b. (i) T (ii) F
c. (i) F (ii) T
d. (i) F (ii) F

FIGURE 1

2. Decide whether each of these statements is True (T) or False (F).

For the ladder diagram shown in Figure (1),

(i) The first rung gives the condition required to reset the counter.

(ii) The second rung gives the condition required to generate pulses to be counted.

- a. (i) T (ii) T
b. (i) T (ii) F
c. (i) F (ii) T
d. (i) F (ii) F

3. Decide whether each of these statements is True (T) or False (F).

For the ladder diagram shown in Figure (1), when there is an input to In 1;

(i) The counter contacts in the third rung closes.

(ii) The counter is ready to start counting the pulses from In 2

- a. (i) T (ii) T
b. (i) T (ii) F
c. (i) F (ii) T
d. (i) F (ii) F

4. Draw the RLD for AND gate application.

5. Define proportional band.

6. Define derivative control action.

7. How will you calculate the reaction rate in process reaction curve method?

8. In an open loop transient response method, $T_i = \dots\dots\dots$ for the PID mode.

9. In ultimate cycling method, for Quarter Amplitude criterion the T_i is calculated as $\dots\dots\dots$ for PI mode.

10. How will you calculate the critical time and critical gain in frequency response method for tuning a controller?

11. IAE stands for $\dots\dots\dots$ & when it is used?

12. Draw a RLD to implement an automatic sequential control system for starting of 3 motors sequentially. The system should follow the following specifications;

- a. When start push button PB1 is momentarily actuated a LUBE oil pump starter coil 1M (motor) is energized.
- b. When LUBE oil pump builds up sufficient oil pressure the lube oil pressure switch PS1 closes and this in turn energizes the coil 2M to start the main drive motor.
- c. 15 sec's after the start of main drive motor a feed motor has to be started by energizing oil 3M.

[5 M]

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