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Question Paper Code: 45504

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2019

Fifth Semester

Electronics and Instrumentation Engineering

14UEI504 - PROCESS CONTROL INSTRUMENTATION

(Regulation 2014)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

- The variable used to maintain the controlled variable at its set point is called
 - controlled variable
 - manipulated variable
 - set point variable
 - process variable
- Dead time is also called
 - pure delay
 - transport lag
 - distance-velocity lag
 - all of the above
- A controller is used to
 - reduce the error by generating a correction signal to the final control element
 - eliminate the disturbance by generating a correction signal to the final control element
 - both (a) and (b)
 - none of these
- The PI controller can be used in _____ control.
 - flow
 - temperature
 - liquid level
 - multi-capacity process
- To suppress errors that persist for long times, the _____ criterion will tune the controllers better.
 - ISE
 - IAE
 - ITAE
 - one quarter decay ratio

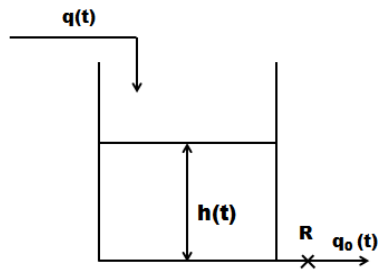
6. The _____ is reasonable trade off between fast rise time and reasonable setting time.
- (a) ISE (b) IAE (c) ITAE (d) one quarter decay ratio
7. In boiler drum, swell effect occurs due to
- (a) sudden load (steam demand) increase
(b) sudden load (steam demand) decrease
(c) feed water pressure variations
(d) level variations
8. Three element control means
- (a) feedback (b) feedback + feedforward
(c) cascade (d) feedforward+cascade
9. The objective of which of the following is to maintain the ratio of two process variables as a specified value.
- (a) feed forward control (b) cascade control
(c) ratio control (d) inferential control
10. In which control loop, output of the controller is divided and sent to two or more control valves
- (a) inferential control (b) feed forward control
(c) ratio control (d) split range control

PART - B (5 x 2 = 10 Marks)

11. Distinguish between continuous process and batch process.
12. Why derivative mode of control is not recommended for a process?
13. Why is it necessary to choose controller settings that satisfy both gain margin and phase margin?
14. An equal percentage has a maximum flow of $50 \text{ m}^3/\text{s}$ and a minimum flow of $2 \text{ m}^3/\text{s}$. If the full travel is 3 cm, calculate the flow at a 1 cm opening.
15. Identify the difference between feed-back control and feed forward control?

PART - C (5 x 16 = 80 Marks)

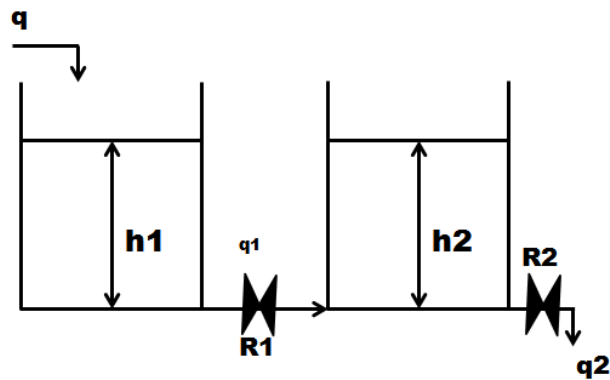
16. (a) (i) Develop the first order transfer function for a liquid level process shown below. Where, q , q_0 are inlet and outlet volumetric flow rates respectively. R – Resistance of the valve and pipe, h – head. (8)



- (ii) Develop a mathematical model for a mercury thermometer. Make necessary assumptions. (8)

Or

- (b) (i) Illustrate servo and regulatory operation with an example for each. (8)
- (ii) Consider the system shown in figure. Develop a mathematical model for the system. Assume that the effluent stream from a tank is proportional to the hydrostatic liquid pressure that causes the flow of liquid. Cross-sectional area of tank 1 is A_1 (ft^2) and of tank 2 is A_2 (ft^2). The flow rates q , q_1 , q_2 are in ft^3/min . Take necessary assumptions. (8)



17. (a) (i) The temperature range of a temperature controller is 250°C to 550°C . The set point is kept at 400°C . Solve the percent of span error when the temperature is 395°C , 400°C and 410°C and also calculate the measured value as percentage of measurement range. (8)
- (ii) A PI controller indicates an output of 12mA when the error is zero. The set point is suddenly increased to 14 mA and the controller output is recorded and is given below. Calculate K_p and T_i . (8)

Time t, sec	0	10	20	30
Output mA	14	16	18	20

Or

(b) Explain the operation of electronic PI and PID controller with suitable circuit diagram. (16)

18. (a) (i) What is the use of evaluation criteria? Explain IAE, ISE, ITAE and $\frac{1}{4}$ decay ratio criteria. (8)

(ii) Explain the process reaction curve method of controller tuning. (8)

Or

(b) (i) Explain the controller settings using Ziegler-Nichols continuous cycling method. (8)

(ii) In the application of the Ziegler Nichols method, a process begins oscillation with a 30% proportional band in an 11.5 min period. Examine (a) The nominal three mode controller settings and (b) Settings to give quarter amplitude response. (8)

19. (a) (i) Explain the working of a simple current to pressure converter with neat diagram. (8)

(ii) Explain the working principle of pneumatic actuated control valve with positioner with the help of neat diagram. (8)

Or

(b) (i) Discuss the factors to be considered before the selection of control valve for a given application. (8)

(ii) Explain the occurrence of cavitations and flashing in control valve. (8)

20. (a) (i) What is split range control? Explain with a simple example. (8)

(ii) Explain the concept of feed forward control with neat diagram. (8)

Or

(b) With suitable example explain the concept of ratio and split-range control. (16)