Reg. No. :

Question Paper Code: 45504

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2018

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)

1. The variable used to maintain the controlled variable at its set point is called

    (a) controlled variable   (b) manipulated variable
    (c) set point variable   (d) process variable

2. Dead time is also called

    (a) pure delay   (b) transport lag
    (c) distance-velocity lag   (d) all of the above

3. Most commonly used controller for controlling the temperature is a _____ controller.

    (a) P   (b) PI   (c) PD   (d) PID

4. The PI controller can be used in _____ control.

    (a) flow   (b) temperature   (c) liquid level   (d) multi-capacity process

5. To suppress errors that persist for long times, the _____ criterion will tune the controllers better.

    (a) ISE   (b) IAE   (c) ITAE   (d) one quarter decay ratio

6. The time constant of a first order system is defined as time for the system to reach following a step input change _____ % of its final value.

    (a) 63.2   (b) 99.8   (c) 85.4   (d) 18.8

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. After installation the equal percentage valve characteristics changes to

   (a) Linear   (b) Quick opening
   (c) No changes   (d) Non linear

10. The _____ can be used to control an unmeasured process output in the presence of unmeasured disturbances.

   (a) cascade control   (b) ratio Control
   (c) ratio split range control   (d) inferential 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. Classify the types of control valve?

14. An equal percentage has a maximum flow of 50 m^3/s and a minimum flow of $2m^3$/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)

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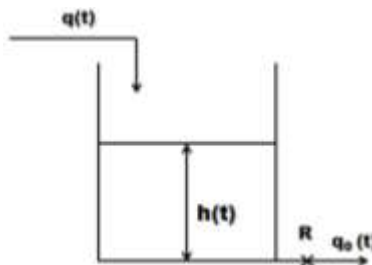
(ii) Develop a mathematical model for a mercury thermometer. Make necessary assumptions. (8)

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 $A1$ (ft^2) and of tank 2 is $A2$ (ft^2). The flow rates q, q_1, q_2 are in ft^2/min. Take necessary assumptions. (8)
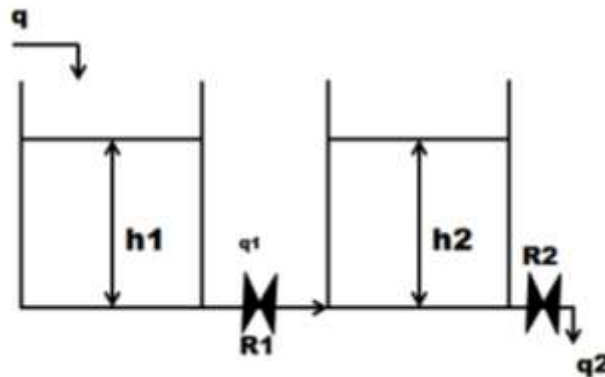
17. (a) A temperature control system inputs the controlled variable in a range of (0 - 4) V. The output is a heater requiring (0 - 8) V. A PID controller is to be designed with K_p = 2.4 % / %, Ki = 9 % / % min, and K_d = 0.7 % / % /min. The period of the fastest expected change is estimated to be 8 sec. Design an electronic PID circuit. Assume C_D =100 µF; R_1 = 10 KΩ ; C_I = 10 µF. (16)

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 ¼ 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)

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(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) Describe the function of an actuator. List the different types of actuators. (8)

(ii) Explain the working principle of pneumatic spring actuator with valve positioner with a help of neat sketch. Mention the drawback of control valve without positioner. (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) Discuss the significance of three element control strategy in boiler drum level and illustrate how it can eliminate the Shrink/ Swell and feed water pressure variation effects. Explain with a help of neat P and I Diagram. (16)

Or

(b) Explain the cascade control scheme with example. (16)

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