A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 56903

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

Sixth Semester

Chemical Engineering

15UCH603 - PROCESS INSTRUMENTATION DYNAMICS AND CONTROL

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The temperature range in which the industrial mercury – in – glass thermometer can be used is _____ CO1- R

   (a) 0 to 100 ^{o}C (b) – 38 to 960 ^{o}F (c) 150 to 1000 ^{o}C (d) 0 to 273 K

2. _____ is used for the measurement of moisture in gases. CO1- R

   (a) Psychrometer (b) pH meter (c) Pirani gauge (d) Sonometer

3. The response of a first-order system to a step input reaches ____ of its ultimate value when the time elapsed is equal to one time constant. CO2- R

   (a) 36.2 % (b) 23.6% (c) 63.2% (d) 50%

4. If the step response of a second-order system is critically damped, the value of damping coefficient (ζ) is _____. CO2- R

   (a) < 1 (b) > 1 (c) Infinity (d) 1

5. The set point is a synonym for the desired value of the _____ variable. CO3- R

   (a) Controlled (b) Disturbance (c) Manipulated (d) Perturbation

6. The output signal from proportional controller is directly proportional to CO3- R

   (a) Offset (b) Rise time (c) Error (d) Static gain

7. Frequency response of a system is with respect to _____ forcing function. CO4- R

   (a) Exponential (b) Sinusoidal (c) Step (d) Ramp

8. Routh test cannot be used to test the stability of a control system containing _____. CO4- R

(a) Transportation lag (b) Phase margin (c) Overshoot (d) Decay ratio

9. _____ control is useful in reducing the effect of a load disturbance that moves through the control system slowly. CO5- R

(a) Feed forward (b) Ratio (c) Smith predictor (d) Cascade

10. An example for mass storage device in computer control system is ___. CO5- R

(a) Printers (b) Magnetic tapes (c) Registers (d) Card reader

PART – B (5 x 2= 10 Marks)

11. Define static error of an instrument. CO1- R

12. State Laplace transform. Mention its applications in process control study. CO2- U

13. Differentiate between servo problem and regulatory problem. CO3- R

14. What are Bode diagrams? Give its physical significance. CO4- U

15. Write notes about smith predictor control strategy. CO5- R

PART – C (5 x 16= 80 Marks)

16. (a) (i) Explain the various dynamic characteristics of a measuring instrument. CO1- U (8)

(ii) With a circuit diagram, describe the working principle of resistance thermometer. CO1- U (8)

Or

(b) (i) Discuss the principle of operation for Calomel reference electrode towards pH measurement. CO1- U (8)

(ii) Explain the principle of viscosity measurement for solutions with a neat sketch. CO1- U (8)

17. (a) (i) Develop the transfer function for a first-order system by considering the unsteady-state behavior of an ordinary mercury-in-glass thermometer. CO2- Ana (10)

(ii) What is linearization? Explain the procedure and applications in control system. CO2- Ana (6)

Or

(b) (i) Derive the transfer function of a process containing transportation lag. CO2- Ana (8)

(ii) A step change of magnitude 4 is introduced into a system having the transfer function CO2- Ana (8)

$$\frac{Y(s)}{X(s)} = \frac{10}{s^2 + 1.6\ s + 4}$$

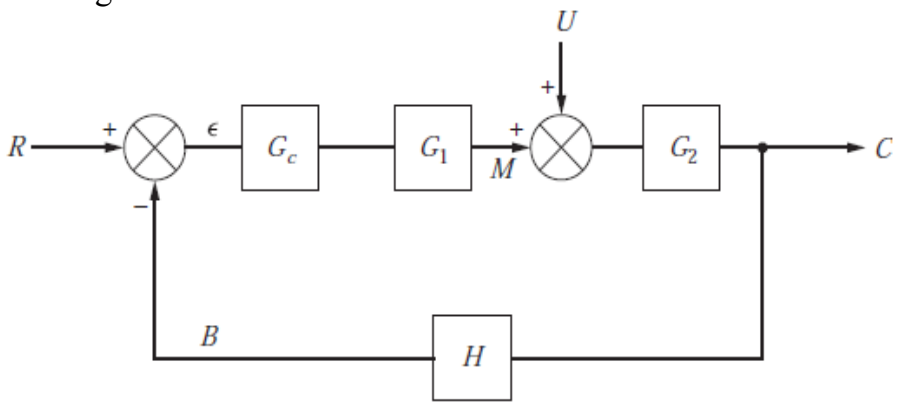
Determine: percent overshoot, rise time, period of oscillation and maximum value of Y(t).

18. (a) Derive the transfer function for proportional – integral – derivative (PID) control action and explain the motivation for the addition of integral and derivative control modes in a control system. CO3- App (16)

Or

(b) (i) What is block diagram? Explain the major components of a block diagram. CO3- Ana (8)

(ii) Consider the block diagram developed for the control of a stirred-tank heater where R = set point, B = value produced by the measuring element and U = load variable. CO3- App (8)



19. (a) Describe the procedure for controller tuning and parameter settings by: Ziegler – Nichols rule and Cohen – Coon (C-C) rule. CO4- U (16)

Or

(b) (i) Explain the steps of Routh test for checking the stability of a control system. CO4- U (10)

(ii) Describe the control system design procedure using Bode stability criterion. CO4- U (6)

20. (a) Explain the development of closed-loop transfer functions for: cascade control system and feed forward control system. CO5- Ana (16)

Or

(b) Discuss the various control strategies implemented for the control of distillate and residue composition in a distillation column. CO5- Ana (16)