KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2024

Marks Scored:

Level : B.E.
Year : III

Course : CHEG 302
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 01 AUG 2024

SECTION "A"

[20 Q. × 0.5 = 10 marks]

Choose and encircle in the most appropriate option from each set of choices

1. Which of the following best describes disturbance variables in a control system?
   a. Variables that are adjusted dynamically to maintain other variables at their set points.
   b. Variables that quantify the performance or quality of the final product.
   c. Variables that represent inputs causing deviation from set points.
   d. Variables that are outputs of the system and remain unchanged.

2. The perfect mixing in process control is termed as
   a. The exit temperature T is also the temperature of the input
   b. The exit temperature T is also the temperature of the tank contents
   c. The exit temperature T is also the temperature of the disturbance input
   d. The exit temperature T is also the temperature of the manipulated input

3. What is the Laplace transformation of *Cos(kt)*
   a. $\frac{1}{S^2+k^2}$ b. $\frac{S}{S^2+k^2}$ c. $\frac{1}{S^2-1}$ d. $\frac{S}{S^2-1}$

4. The transfer function of second-order system
   a. $\frac{1}{\tau^2S^2+1}$ b. $\frac{1}{\tau^2S^2+2\tau S+1}$ c. $\frac{1}{\tau^2S^2+2\xi\tau S-1}$ d. $\frac{1}{\tau^2S^2+2\xi\tau S+1}$

5. The approximation of dynamic behavior of the composition sensor-transmitter can be made by considering
   a. a first-order transfer function
   b. a second-order transfer function.
   c. a third-order transfer function
   d. can't be approximated

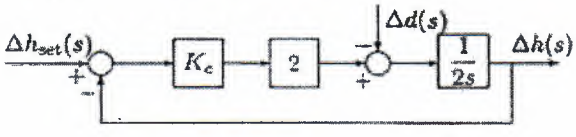
6. Bode diagram is a plot of
   a. log (AR) vs. log (f) and (φ) vs. log (f)
   b. log (AR) vs. (f) and log (φ) vs. (f)
   c. AR vs. log (f) and (φ) vs. log (f)
   d. log (AR) vs. φ

7. The limitation of On-off controller is due to the
   a. Excessive wear on control valve
   b. Output increase
   c. Input increase
   d. Excessive error

8. Final control element is
   a. Valve b. Switch c. Signal d. Regulator

9. The block diagram of an integral level process is given below. For unit step change in the set point $\Delta h_{set} = 1$ with $\Delta d = 0$, the offset exhibited by the system is

   a. $\frac{K_c}{1+K_c}$ b. $\frac{1}{1+K_c}$
   c. 0 d. $\frac{2K_c}{1+2K_c}$



10. Frequency response mean
    a. Transient response of a system to a sinusoidal input
    b. Steady state response of a system to a sinusoidal input
    c. Oscillatory response of a system to a sinusoidal input
    d. Oscillatory response of a system to a sinusoidal output

11. Most commercial valves move from fully open to fully closed as the valve-top pressure changes from
    a. 2 to 6 psig b. 4 to 8 psig c. 3 to 15 psig d. 4 to 9 psig

12. Which of the following controllers has maximum offset?
    a. P-Controller b. P-I Controller c. P-D Controller d. P-I-D Controller

13. Feed forward controller account for ---------- changes.
    a. Set point b. Load c. Gain d. Offset

14. Closed-loop response becomes less oscillatory and more stable with
    a. constant τ_I b. increasing K_c or increasing τ_I
    c. decreasing K_c or decreasing τ_I d. decreasing Kc or increasing τ_I

15. Which of the following is not the feature of modern control system?
    a. Quick response b. Accuracy
    c. Correct power level d. No oscillation

16. A control system whose step response is $-0.5(1+e^{-2t})$ is cascaded to another control block whose impulse response is e^{-t}. What is the transfer function of the cascaded combination?
    a. 1/(s+2)(s+1) b. 1/(s+1)s c. 1/(s+3) d. 0.5/(s+1)(s+2)

17. Which of the following best describes the servomechanism-type (servo) problem in the context of a control system?
    a. The control system handles changes in load T_i to maintain a constant bath temperature.
    b. The control system assumes no change in load T_i and focuses on changing the bath temperature according to a prescribed function of time.
    c. The control system adjusts the load T_i to match the desired variation in bath temperature.
    d. The control system does not consider bath temperature and only focuses on load changes over time.

18. If the initial conditions for a system are inherently zero, what does it physically mean?
    a. The system is at rest but stores energy
    b. The system is working but does not store energy
    c. The system is at rest or no energy is stored in any of its part
    d. The system is working with zero reference input

19. For the transfer function $G(s)=\frac{K(1+\tau_3 s)}{(1+\tau_1 s)(1+\tau_2 s)}$, the system has fast response if
    a. $\tau_3 < 0$ b. $\tau_3 > 0$ c. $K < 0$ d. $K > 0$

20. Amplitude ratio (AR) is defined
    a. $\frac{Output\ amplitude}{Input\ amplitude}$ b. $\frac{input\ amplitude}{Output\ amplitude}$ c. $\frac{1}{Input\ amplitude}$ d. $\frac{1}{Output\ amplitude}$

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SECTION "B"
[40 marks]

Attempt *ALL* questions.

1. a. Discuss the initial and final value theorems. [2]
   b. Solve the following equation for x(t) [3]

$$\frac{d^2x}{dt^2}+2\frac{dx}{dt}+2x=2, \text{ where } x(0)=x'(0)=0$$

2. Draw and explain the block diagram of major steps in control system development. Explain feedback and feed forward control system. Derive transfer function equation of a Blending Process. [10]

3. What do you mean by general stability criterion? Discuss contributions of characteristic equation roots to closed-loop response. [5]

4. What do you mean by Gain, Phase Margin and Offset? Explain Zigler-Nichols controller settings. [3+7]

5. Discuss *ALL* [2+2+2+2+2]
   a. Different types of controllers
   b. Properties of Transfer Function Models
   c. Response of first order system
   d. Block diagram of Chemical-reactor system
   e. Bode diagram