

Process Control & Instru.

(3 Hours)

Max. Marks: 80

Note:

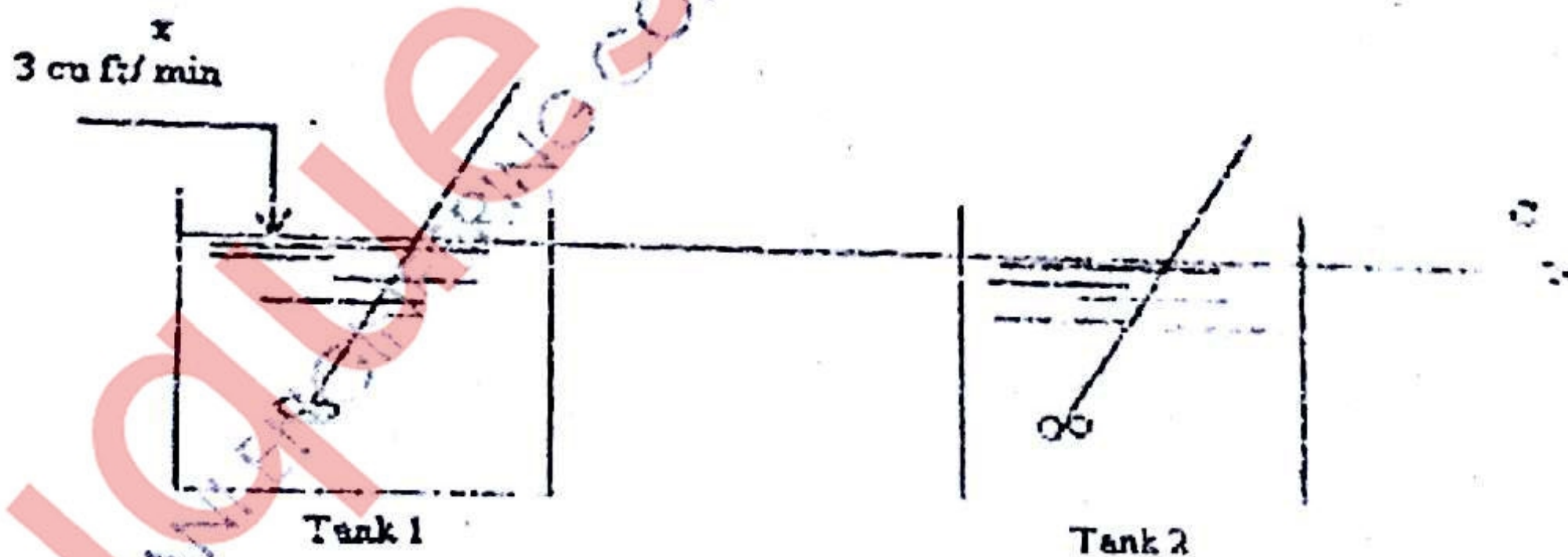
1. Question No. 1 is compulsory.
2. Attempt any three questions out of remaining five questions.
3. Assume suitable data wherever necessary.
4. Figures to right indicate full marks.

Q.1 Answer the following (Any four)

- a. Explain Bode diagram for transportation lag. 05
- b. Derive the transfer function for damped vibrator. 05
- c. Explain valve positioners. 05
- d. In a PID controller the error is increased linearly at the rate of $5^{\circ}\text{C}/\text{min}$. The proportional sensitivity of PID controller is 4. The reset rate is 1 and the derivative time τ_D is 0.5. Obtain the response equation of the controller and plot the response. 05
- e. Differentiate between positive and negative feedback control system. 05

- Q.2 a. Derive the transfer function of two tank interacting system. 10
- b. What is cascade control? What are the advantages of cascade control? 05
- c. Explain Bourdon tube pressure gauges. 05

- Q.3 a. In the two tank mixing process shown in the figure, x varies from $0 \text{ lb salt}/\text{ft}^3$ to $1 \text{ lb salt}/\text{ft}^3$ according to a step function. At what time does the salt concentration in the tank-2 reaches $0.6 \text{ lb salt}/\text{ft}^3$? The hold up volume of each tank is 6 ft^3 . 10



- b. Determine the stability of the control system having open loop transfer function as 10

$$G(s) = \frac{K_c}{s(s+1)(s+2)}$$

Determine K_c for which the system just causes instability.

- Q.4 a. Sketch the Bode diagram for the two tank non-interacting first order systems in 10

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(2)

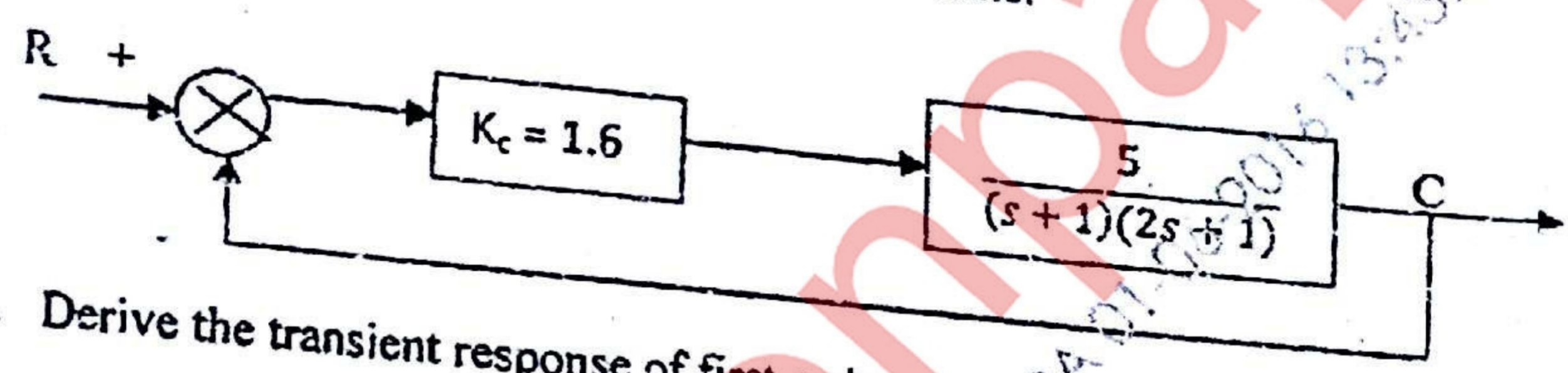
series having time constants $\tau_1 = 10$, $\tau_2 = 0.5$. A proportional controller with gain K_c is used to control the system.

- b. Discuss the motivation for addition of integral and derivative control modes with the proportional controller.
- c. Derive the offset of P- controller for regulator mechanism control.

Q.5 a. A set point of the given control system is given a step change of 0.1 unit. Determine

- i) Maximum value of C and the time at which it occurs.
- ii) The offset
- iii) The period of oscillation

Draw the sketch of C(t) as a function of time.



b. Derive the transient response of first order system for a ramp change.

Q.6 Write a note on (any four)

- a. PI and PD controller
- b. Transient response of first order system for unit step change
- c. Adaptive control
- d. Nyquist criteria
- e. Gain and phase margin

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