SOLUTION

BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE PILANI

SECOND SEMESTER 2022-2023

CHE F342: Process Dynamics& Control

Mid-Term Test **Date: 18.03. 2023**

Duration: 2:00 - 3:30 PM **Max. Marks: 90 Min**

Name: **Roll No:**

Section-I: *PART A (Close Book) : Answer the questions in the space provided* ***10 x 2= 20 M***

1. The system has a transfer function $G(s) = \frac{3e^{-3s}}{(s+3)}$. When a step change of magnitude is ***M*** is given to the system input, the final value of the output is measured to be 40. The value of ***M*** is

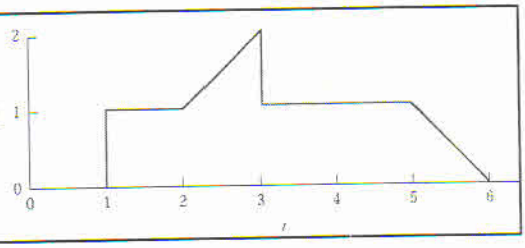
40

2. Two 1st order tanks are connected in a non-interacting manner. For a given step change in inlet flow rate, the nature of the response of the 2nd tank height is_ ($A_1 = A_2 = 1\ m^2$, $R_1 = R_2 = 1\ sec/m^2$, linear)

Non oscillatory / Stable response

3. The Laplace transform *f(s)* for the following *f(t)*

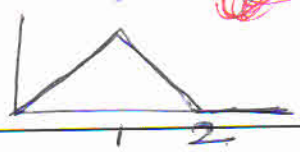
$$\frac{e^{-s} - e^{-3s}}{s} + \frac{e^{-2s} + e^{-6s} - e^{-3s} - e^{-5s}}{s^2}$$



4. Plot *f(t)*, if a forcing function f(t) has the Laplace transform $f(s) = \frac{1-2e^{-s}+e^{-2s}}{s^2}$.

$$t.u(t) - 2(t-1)u(t-1) + (t-2)u(t-2)$$

f(t)



5. $\frac{dx}{dt} = \int_0^t x(t)dt - t\,; x(0) = 3,$ *then* $x(t)$*is*

$$x(t) = 1 + e^{-t} + e^{t}$$

6. A process of unknown transfer function is subjected to a unit-impulse input. The output of the process is measured accurately and is found to be represented by the function $y(t) = te^{-t}$. Determine the unit-step response of this process.

$$1 - e^{-t} - te^{-t}$$

7. A unit gain 2nd order underdamped process has a period of oscillation 1.0 second and a decay ratio 0.25. The transfer function of the process is_

$$P.O = \frac{2\pi\tau}{\sqrt{1-\zeta^2}} \qquad \tau = 0.1549$$

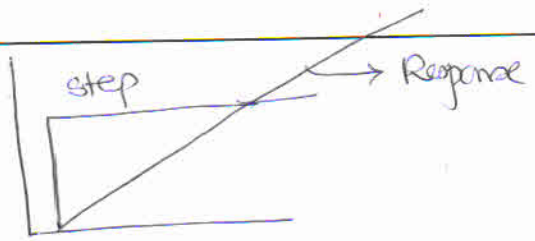
$$D.R = \exp\left(\frac{-2\pi\zeta}{\sqrt{1-\zeta^2}}\right) \qquad \zeta = 0.2162$$

$$\frac{1}{(0.1549s)^2 + 2(0.2162)(0.1549)s + 1}$$

8. A unit step change is given to a pure capacitance system. Draw the nature of the response and indicate the step input in the plot.

$\zeta = 0.2162$

$\tau \neq 0.1549$



9. If $G(s) = \frac{1}{s+1} - \frac{2}{s+4}$, upon a unit step change in disturbance at t = 0, then the slope at t= 0⁺(just after the step change) is _____ & is the response stable?

Slope is negative ∴ Inverse response.

10. Compare the responses of a second order system with ξ= 0.01, 0.1, 1 & 2 for a given unit step change in load vaiable. (indicate the ξ values on the responses)