NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF CHEMICAL ENGINEERING

PROCESS DYNAMICS, MODELING AND CONTROL

TCE 5202

Supplementary Examination Paper

24 August, 2024

This examination paper consists of 4 pages

Time Allowed: 3 hours

Total Marks: 100

INSTRUCTIONS

1. Answer **any four** questions
2. Each question carries 25 marks
3. Use of calculators is permissible

MARK ALLOCATION

QUESTION	MARKS
1.	**25**
2.	**25**
3.	**25**
4.	**25**
5.	**25**
TOTAL ATTAINABLE MARKS	**100**

QUESTION 1

A. What are the two (2) most common ways to control systems with Inverse Response? **[4]**

B. Explain with the aid of a fully labeled diagram how an Inverse Compensator can be used to stabilize the process shown in Fig Q1B. Derive relevant expressions to support your explanation. **[21]**

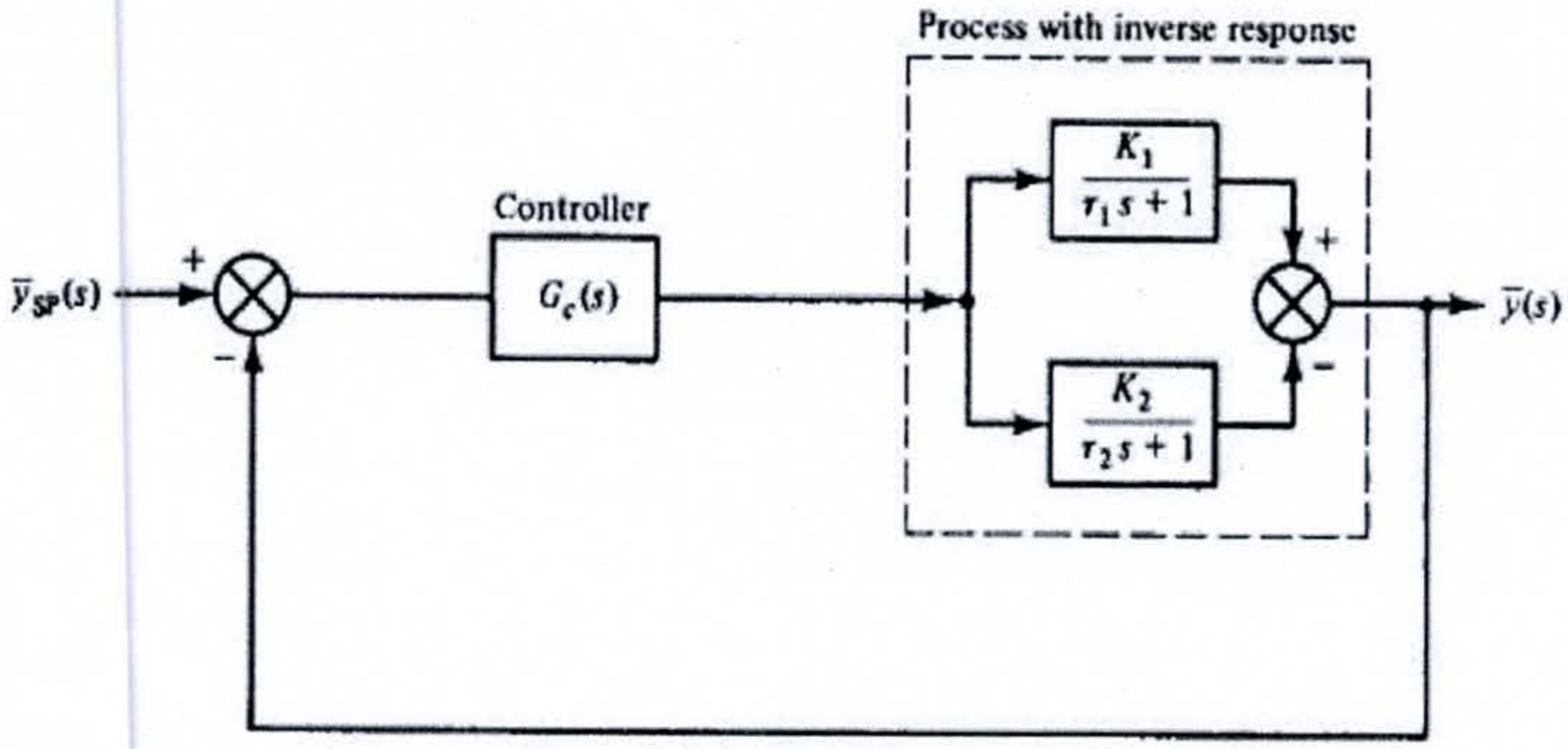

Fig Q1B Feedback control with inverse response

QUESTION 2

A. Explain any three (3) causes and any three (3) effects of dead-time or delay-time on chemical processes? **[12]**

B. Explain four (4) advantages and two (2) disadvantages of using a Cascade control system in control of chemical processes. **[13]**

QUESTION 3

Consider a process with the following input-output relationships:

$$\bar{y}_1 = \frac{1}{s+1}\bar{m}_1 + \frac{1}{0.1s+1}\bar{m}_2 - - - 1$$

$$\bar{y}_2 = \frac{-0.2}{0.5s+1}\bar{m}_1 + \frac{0.8}{s+1}\bar{m}_2 - - - 2$$

Compute the relative gains for a unit step change in each of the transfer functions and determine the recommended pairing. **[25]**

QUESTION 4

A. Explain briefly why singular value analysis (SVA) is important as an analytical tool in control system problems. **[12]**

B. With the aid of a diagram explain how a ratio control system works in controlling chemical processes. **[13]**

QUESTION 5

Consider the on-line blending system shown in Fig Q5. It is proposed that w and x can be controlled using a conventional multiloop control scheme, with w_A and w_B as the manipulated variables. Derive an expression for RGA and recommend the best controller pairing for the following blending conditions: $w = 4$ kg/min and $x = 0.4$.

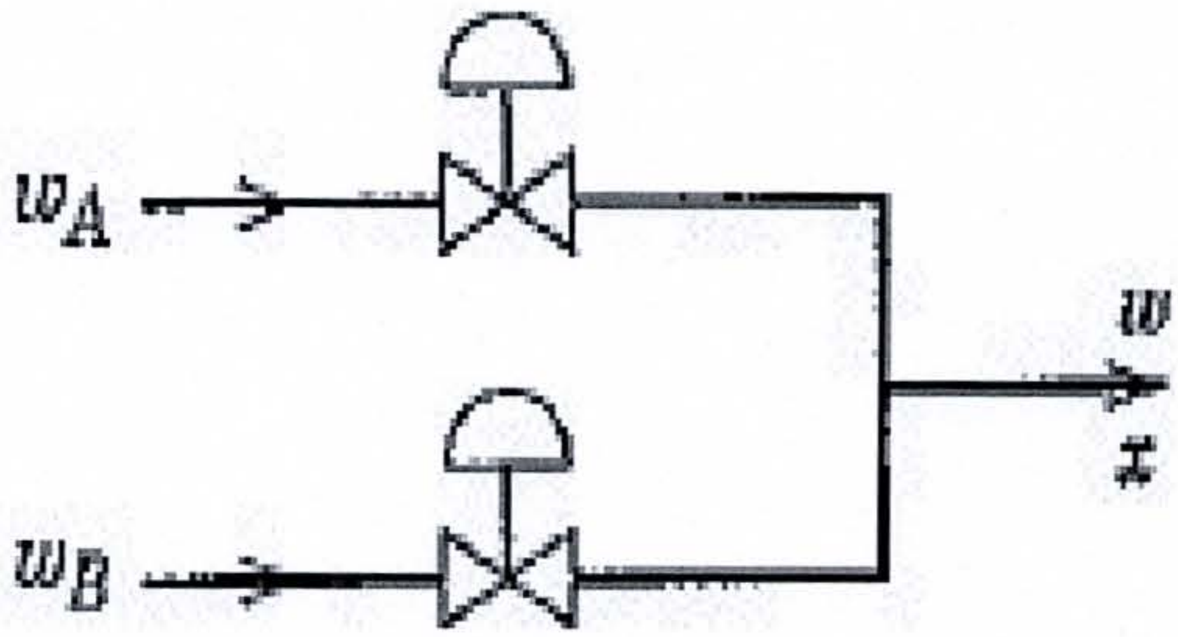

Fig Q5 On-line blending system

END OF SUPPLEMENTARY EXAMINATION QUESTION PAPER!!!!!!!