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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION**(R&S)**, MAY 2019 **Pages 3**

Pages: 1

Course Code: AE302

Course Name: PROCESS CONTROL

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1	a)	degrees of freedom (5), example(3),diagram(2)	(10)
	b)	Incentives for process control.(5)	(5)
2	a)	Steady state gain(2),Process time constant(2)	(5)
	b)	Liquid level control(5)Temperature control(5)	(10)
3	a)	self-regulating system(3), non-self-regulating system(3),Diagrams(2).	(8)
	b)	Description(5),diagrams(2)	(7)

PART B

Answer any two full questions, each carries 15 marks.

4	a)	elements of a feedback control loop(7),diagrams(3)	(10)
	b)	***<u>*Marks for attempting the question</u>***	(5)
5	a)	Cascade control (5), example(3), diagrams(2)	(10)
	b)	***<u>*Marks for attempting the question</u>***	(5)
6	a)	feed forward control(7), diagrams(3)	(9)
	b)	time integral performance criteria(5)	(6)

INTEGRAL ERROR MEASURES. These indicate the cumulative deviation of the controlled variable from its set point during the transient response. Several such measures are used:

Integral of the absolute value of the error (IAE):

$$\text{IAE} = \int_0^\infty |\text{SP}(t) - \text{CV}(t)|\, dt \qquad (7.1)$$

Integral of square of the error (ISE):

$$\text{ISE} = \int_0^\infty [\text{SP}(t) - \text{CV}(t)]^2 dt \qquad (7.2)$$

Integral of product of time and the absolute value of error (ITAE):

$$\text{ITAE} = \int_0^\infty t\, |\text{SP}(t) - \text{CV}(t)|\, dt \qquad (7.3)$$

Integral of the error (IE):

$$\text{IE} = \int_0^\infty [\text{SP}(t) - \text{CV}(t)] dt \qquad (7.4)$$

#ref 8:Thomas E Marlin - Process Control- Designing processes and Control Systems for Dynamic performance, McGraw-Hill International Editions

PART C

Answer any two full questions, each carries 20 marks.

7	a)	principle of model predictive control(7), drawings(3)	(10)
	b)	Classification of artificial neural network(5)	(5)

crisp set (2) fuzzy set(3) (5)

8 a) process interaction in a multivariable system(9),diagrams(3) (12)

b) Operating window(4), Controllability(4) (8)

20.3 ▫ INFLUENCE OF INTERACTION ON THE POSSIBILITY OF FEEDBACK CONTROL

Previously, some basic requirements were stated for the variables involved in a single-loop feedback control system. Briefly, the controlled variable should be closely related to process performance; the manipulated variable should be independently adjustable; there should be a causal relationship between the manipulated and controlled variables; and the dynamics should be favorable. These guidelines are still useful, but a somewhat more thorough analysis is required for multivariable systems, because range and controllability are influenced by process interactions.

Operating Window

The first issue is the control system's range of attainable variable values. The term *operating window* will be used for the range of possible (or feasible) steady-state values of process variables that can be achieved with the equipment available. The operating window can be sketched using different variables as coordinates; in one approach, the controlled variables are used to characterize the range of possible set points, with all disturbances constant. Another common approach is to use the disturbance variables as coordinates to characterize the range of disturbance values that can be compensated by the control system (i.e., for which the con-

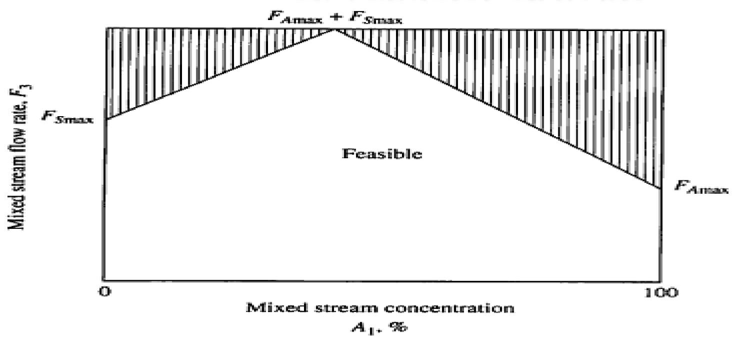

FIGURE 20.5
Operating window for blending with controlled variables as coordinates.

Controllability

Another important issue in multivariable control is the independence of the input-output process relationships between selected manipulated variables (MV_j's) and controlled variables (CV_i's); a process in which the relationships are independent is termed *controllable*. Many definitions for the term *controllability* are used in automatic control (e.g., Franklin et al., 1990); for the purposes of this book we will use the following definition, which is appropriate for continuously operating plants that should attain steady-state conditions (a somewhat less restrictive version of Rosenbrock's (1974) "functionally controllable (f)"):

> A system is **controllable** if the controlled variables can be maintained at their set points, in the steady state, in spite of disturbances entering the system.

#ref 8:Thomas E Marlin - Process Control- Designing processes and Control Systems for Dynamic performance, McGraw-Hill International Editions

9 a) step analysis method to find time constants and dead time for a second order model (8),diagrams(2) (10)

b) relative gain array(7) loop pairing (3) (10)