Exam Date & Time: 19-May-2022 (10:00 AM - 01:00 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

SIXTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, MAY 2022 SYSTEM IDENTIFICATION [ICE 4054]

A

Marks: 50

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed 1) Explain any one statistical method to detect the outliers in system identification.

(3)

(4)

Duration: 180 mins.

- A)
- B) The experimental input and output data of a system is given in table 1B, by using least square estimation fit the data with line equation y=mx+c and also find the error at x=20.

Table 1B: Experimental data

x	1	4	7	8	13	16	20	23	28	31
у	0.5	2	3.5	6	12	14	17	21	26	27

- C) A tank system is having time constant of 0.5 min and resistance of 0.25 min/m² is operating at steady state with an inlet of flow 2 m³/min. the flow is suddenly increased to 3 m³/min. Plot the response of tank level. Assume tank area $a=2m^2$ (3)
- 2) Find the transfer function $H_2(s)/Q(s)$ and $H_3(s)/Q(s)$ for a three system shown in figure 2A. Where H_2 , H_3 (4) and Q are deviation variables. For a unit step change in Q, determine the initial and final heights in tank 3.

A)



Fig 2A: three tank system.

B)	Derive expressions for unknown parameters in the generalized ARMAX(2,2,1) model.

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()	Illustrate the	empirical	transfer	Tunction	model
-)		r			

3) The experimental input and output data of a system is given in a table 3A, identify the FOPTD (4) model by using two point method.

A) Table 3A

Time in sec	Output	input
1	47.5	15
2	47.5	40
3	47.6	40
4	48	40
5	48.8	40
6	49.8	40

(4)

(2)

7/22/22, 11:34 AM

7	51	40
12	53.2	40
13	54.2	40
17	57.6	40
21	60.2	40
25	62.2	40
29	63.7	40
33	64.9	40
37	65.8	40
38	66	40
54	67.9	40
64	68.5	40
80	68.5	40

ICE 4054

B) List the guidelines required for the choice of the candidate models in system identification.

C) Derive the generalized step response model and explain the properties of frequency response model.

4)

A)

- The experimental data of reactor is given in table 4A, where u(t) is an input and y(t) is an output. (5)
 - i. Draw input and output of a reactor
 - ii. Identify the ARX model.

Note: take order 1 and delay 2

Table 4A: Data

Time	1	2	3	4	5	6	7	8	9	10	11
$u(t) (m^3/s)$	1	1	1	1	1	-1	-1	-1	-1	-1	-1
$y(t) (kg/m^{3})$	0	0.13	0.09	0.10	0.10	0.10	-0.17	-0.08	-0.11	-0.10	-0.10

(2)

(4)

ICE 4054

B)	With proper diagrams, explain the procedure of system identification.	(3)
C)	Describe the significance of signal to noise ratio in system identification	(2)
5)	Find the minimum sampling rate for a continuous-time signal $x(t) = 2 \sin(60\pi t) + 0.5 \sin(100\pi t) + 10 \sin(20\pi t)$.	(2)
A) B)	With an example, differentiate quantitative and qualitative models.	(2)
C)	Explain the following	(3)
	i. Box - Jenkins model	(5)
	ii. Overfitting	

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