Reg. No. | | | | | | | | | | |

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

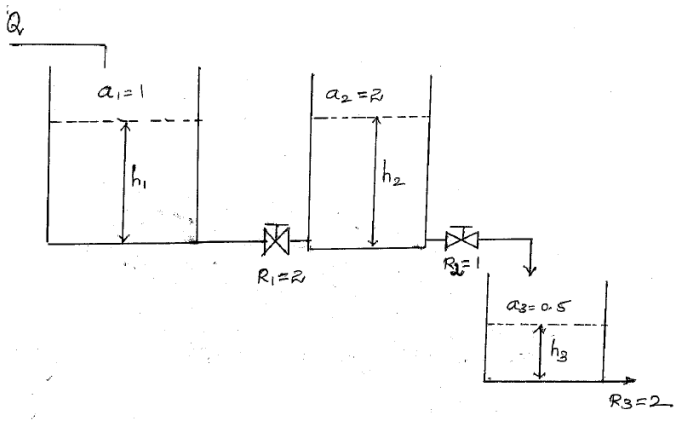
SIXTH SEMESTER B.TECH. (ELECTRONICS & INSTRUMENTATION ENGG.)
ONLINE GRADE IMPROVEMENT/MAKE-UP EXAMINATIONS, AUGUST - 2021

SUBJECT: SYSTEM IDENTIFICATION [ICE4054][PE-I]

TIME: 2 HOURS 10-08-2021 **MAX.MARKS: 40**

Instructions to candidates: Answer any *FOUR FULL* questions.

Missing data may be suitably assumed.

1A.	The flow rate through an exit pipe is given by a relation $F_o=6\sqrt{h}$ where h is the tank level in meters. Find the time constant for the stedy state levels of 2m and 5m, cross sectional area of tank is $2m^2$.
1B.	Find the transfer function $H_2(s)/Q(s)$ and $H_3(s)/Q(s)$ for a three system shown in Fig.Q1B. Where H_2, H_3 and Q are deviation variables. For a unit step change in Q, determine the initial and final heights in tank 3.  Fig.Q1B
	(4+6)
2A.	Explain guidelines required for the choice of candidate models in system identification.
2B.	With a neat diagrams, describe the procedure of system identification.
	(5+5)
3A.	Illustrate the applications of models in process systems engineering.
3B.	Write a Mat lab code to generate input and output data for a system whose transfer function is $G(s)=1/(s+2)^2$
	(5+5)

4A. The experimental data of reactor is given in Table 4A, where u(t) is an input and y(t) is an output.

i. Draw input and output of a reactor

ii. Identify the ARX model.

Note: take order 1 and delay 2

Table 4A:

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

4B Derive the generalized frequency response model. Also explain the properties of impulse response model.

(6+4)

5A. With a proper example, explain the effect of Signal to Noise ratio in the system identification.

5B. The impulse response of a discrete-time system is given by

$$g[k] = (0.4)^{k-1} + 2(0.6)^{k-1}, \quad k \geq 1$$

i) Plot the impulse and step responses of the system. Is the system causal and stable?

ii) Arrive at the frequency response function $G(e^{jw})$ of the system. Plot the magnitude and phase response of the system.

iii)Write the corresponding input-output difference equation and the transfer function representation that describes the system.

iv) Compute an appropriate FIR approximation of the system by hand.

v) Use a PRBS input (frequencies in the band f 2 [0 0:2] cycles/sample) to excite the system. Obtain measurements by adding random noise (white), while adjusting its variance such that SNR sets to 10.

(3+7)

6A. The experimental input and output data of a system is given in Table 6A. By using least square estimation fit the data with a line represented as y=mx+c and also find the error at x=20.

Table 6A: Experimental data

x	1	4	7	8	13	16	20	23	28	31
y	0.5	2	3.5	6	10	12	17	20	26	25

6B. Derive the generalized output error model and explain the cross - covariance function properties.

(5+5)

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