

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institution of Manipal University

FIRST SEMESTER M.TECH (CONTROL SYSTEMS ENGINEERING) END SEMESTER EXAMINATIONS, NOV- 2017

SUBJECT: SYSTEM MODELING AND IDENTIFICATION [ICE 5123]

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Missing data may be suitably assumed.
- 1A. A random sample of 20 pieces of cotton fiber was taken and the absorbency on each 4 piece was measured. The following are the absorbency values:

18.71, 21.41, 20.72, 21.81, 19.29, 22.43, 20.17, 23.71, 19.44, 20.50, 18.92, 20.33, 23.00, 22.85, 19.25, 21.77, 22.11, 19.77, 18.04, 21.12

- (a) Calculate the sample mean and median for the above sample values.
- (b) Compute the 10% trimmed mean.
- (c) Calculate the sample variance and standard deviation.
- 1B. If a car agency sells 50% of its inventory of a certain foreign car equipped with side 4 airbags, find the probability distribution of the number of cars with side airbags among the next 4 cars sold by the agency. Also find the cumulative distribution function of the random variable X.
- **1C.** Suppose that the error in the reaction temperature, in ⁰C, for a controlled laboratory **2** experiment is a continuous random variable X having the probability density function

$$f(x) = \begin{cases} \frac{x^2}{3}, & -1 < x < 2\\ 0, & \text{elsewhere} \end{cases}$$

a). Verify that f(x) is a probability density function

- b). Find $P(0 < X \le 1)$
- 2A. A study was made on the amount of converted sugar in a certain process at various 4 temperatures. The data were coded and recorded as follows:

Temperature, x	Converted Sugar, y
1.0	8.1
1.1	7.8
1.2	8.5
1.3	9.8
1.4	9.5
1.5	8.9
1.6	8.6
1.7	10.2
1.8	9.3
1.9	9.2
2.0	10.5

Table Q2A

(a) Estimate the linear regression line.

(b) Estimate the mean amount of converted sugar produced when the coded temperature is 1.75.

(c) Plot the residuals versus temperature. Comment.

- 2B. For the data given in table of Q2A, calculate SSE, SSR, SST, R², and r values. 4 2C. Write a note on linear regression model using matrices. 2 3A. Explain Frequency Response Identification and its types. 2 3B. Compare discrete and continuous transfer functions and its transformation methods. 4 3C. List the common black box SISO models and write the equations for all the models. 4 4A. What is Pseudo-Random Binary Signal? Write a note on its properties and explain how it 3 can be generated. 4B. What do you understand from ARX model? Write a note on Identification of an ARX 4 system. 3 **4C.** Write a note on statistical model identification. For the process response given in Fig Q5A, calculate the models using a) Process 5A. 6 reaction method and b) Two-point method.
- For the process response given in Fig Q5A, find the PID parameters using ZN method and 5B. 4 any other method of your choice. Compare and comment.

