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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (S,FE) Examination January 2026 (2019 Scheme)

Course Code: MAT256

Course Name: PROBABILITY AND STATISTICAL MODELLING

Max. Marks: 100 **Duration: 3 Hours**

(Statistical tables are allowed)

PART A

(Answer all questions; each question carries 3 marks) Marks

1 For the random variable X has the following probability distribution 3

x	-2	-1	0	1	2	3
P(x)	1/ 10	k	2/10	2k	3/10	3k

Find (i) value of k (ii) p(x<2)

2 If X follows Poisson distribution with mean 6. Find p(x=1). Also find V(x) 3

3 The density function of two dimensional random variable (x, y) is given by 3

$f(x,y) = \begin{cases} e^{-(x+y)}; & x\geq 0 \ ; y\geq 0 \\ 0, & elsewhere \end{cases}$. Check whether X and Y are independent.

4 Suppose the reaction temperature X (in ^{0}C) in a certain chemical process has a uniform distribution with (-5,5).Compute p(x<0). 3

5 What is mean by sampling theory? 3

6 A random sample of 400 people,172 were males. Estimate the population proportion at 95% confidence level. 3

7 The average life of 26 electric bulbs were found to be 1200 hrs with s.d. of 150 hrs. Test whether these bulbs could be considered as a random sample from a normal population with mean 1300 hrs 3

8 A researcher wishes to test the claim that the average cost of tution and fees at a two year college is greater than 5550 dollar. She select a random sample of 36 two year colleges and find the mean is to be 5800 dollar and the population standard deviation is 600 dollar. Is there any evidence to support the claim at α =0.05.? Use P-value method. 3

9 Explain the least square method for fitting a straight line for a given data. 3

10 Calculate the regression coefficient of the following data. 3

X	3	9	5	3
Y	8	6	4	2

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11 a) Find a and b if Y= aX+b has mean 4 and variance 16, where X is a random variable with mean 8 and variance 4 . 7

b) Derive the Poisson distribution as a limiting case of Binomial distribution. 7

12 a) The joint probability mass function of random variable X and Y is given by 7

$$f(x,y) = \begin{cases} \frac{x(x+y)}{70} & , x=1,2,3, \text{ and } y=3,4 \\ 0 \quad otherwise \end{cases}$$

Find (a) E(x) and E(y) (b) Check whether X and Y are independent.

b) A particular telephone number is used to receive both voice call and fax messages. Suppose that 25% of the incoming calls involves fax messages and consider a sample of 25 incoming calls , what is the probability that 7

(a) At most 6 of the calls involves fax messages.

(b) At least 6 of the calls involves fax messages.

Module -2

13 a) If X follows normal distribution with mean 65 and standard deviation 9. Find (a) $P(X<54)$ (b) $P(X\geq80)$ (c) $P(70<X<80)$ 7

b) Derive the Mean and Variance of Exponential distribution. 7

14 a) On a large group of men 5% are under 60 inches in height and 40% are in between 60 and 65 inches. Assuming the distribution is normal find the mean and standard deviation. 7

b) The mileage of car owners get with a certain kind of radial tyre is a random variable having an exponential distribution with mean 40,000 Km. Find the probability that one of these tyre will last 7

(a) At least 20,000Km (b) At most 30,000 Km

Module -3

15 a) A random sample of 64 mangoes taken from a large consignment some were found to be bad. Deduce that the percentage of bad mangoes in the consignment almost certainly lies between 31.25 and 68.75, given that the standard error of proportion of bad mangoes in the sample is $\frac{1}{16}$. 7

b) Given the following information , universe with N=10,000 and variance of weight of cereal containers on the basis of past records is 8kg.Determine the size of the

sample for estimating the true weight of containers if the estimate should be within 0.4kg of the true average weight with 95% probability. What would be the size of the sample if infinite universe is assumed? 7

16 a) From a sample packet containing iron nails of 1000, 100 were found to be defective. Estimate the percentage of defective nails and also assign the limit in which the probability lies ? 7

b) A survey is proposed to be conducted to know the annual earning of old statistic graduates in Delhi University . How large should be the sample in order to estimate the mean monthly earning within ± Rs10,000 at 95% confidence level? The standard deviation of the annual earning of the entire population is Rs±30,000 7

Module -4

17 a) A sample of 400 male students is found to have a mean height of 67.47 inches. Can it be reasonably regarded as a sample from a large population with mean height 67.39 inches and S.D 1.30 inches? Test at 5% level of significance? 7

b) The mean produce of wheat of a sample of 100 fields in 200lbs per acre with a S.D of 10 lbs .Another sample of 150 fields gives the mean of 220 lbs with S.D 12lbs. Can the two samples be considered to have been taken from the same population whose S.D is 11lbs?.Use 5% level of significance? 7

18 a) A certain process produces 10 percent defective articles. A supplier of new raw materials claims that the use of his material would reduce the proportion of defective. A random sample of 400 units using this new material was taken out of which 34 were defective units. Can the supplier claim be accepted? Test at 1% level of significance. 7

b) Set up an analysis of variance table for the following per acre production data for three varieties of wheat each grown 4 plots and state if the variety difference are significant.

Plot of land	variety of wheat		
	A	B	C
1	6	5	5
2	7	5	4
3	3	3	3
4	8	7	4

Module -5

19 a) Based on the following data it is suggested that thermal conductivity(y) of poly thylene is a linear function of $\frac{10^4}{x}$,where x is lamellar thickness in A^0 7

X	240	410	460	520	590	745	830
Y	12	14.7	15.2	15.2	15.6	16	18

Estimate (a) Regression function and (b) Predict value of thermal conductivity when lamellar thickness is 500 A^0

b) The flow rate y(m^3/min) in a device used for air quality measurement depends on the pressure drops x(inches of water) across the device filter. Suppose for x values between 5 and 20 the two variables are related according to the simple linear regression model with regression line Y= -0.12 +0.095x. What is the expected change in flow rate associated with 1inche increase in pressure drops? Explain what change in flow rate can be expected when pressure drop decreases by 5 inches? 7

20 a) In the following data, X= current density ($Ma/cm^{2)}$ and Y= rate of deposition (μm/min.).calculate coefficient of correlation.

X	20	40	60	80
Y	0.24	1.20	1.71	2.22

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b) Suppose the variables x=commuting distance and y= commuting time are related according to the simple linear regression model with σ= 10 .If n=5 observations are made at the x values x_1=5 ,x_2=10, x_3=15, x_4=20, x_5=25 ,Calculate the standard deviations of the five residuals. 7

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