



**M.E / M.TECH DEGREE EXAMINATIONS: NOV/ DEC 2024**

(Regulation 2024)

First Semester

**COMMON TO CM / EE / BT**

24MAI501: Statistical Methods for Engineers

**COURSE OUTCOMES**

- CO1: Apply different method and techniques to estimate statistical parameters  
 CO2: Apply various statistical methods for hypothesis testing of sample data  
 CO3: Apply hypothetical testing to compare and assess the independence of attributes  
 CO4: Apply multiple and partial correlation analysis, least squares regression in determining the factors relating engineering data  
 CO5: Analyse the effectiveness of experimental designs through Analysis of Variance  
 CO6: Apply the multivariate concepts and compute covariance and correlation matrices

**Time: Three Hours**

**Maximum Marks: 100**

**PART A (4\*20 = 80 Marks)**

1. a) List the properties of sufficient estimators. 2 CO1 [K<sub>1</sub>]  
 b) Define estimator of the parameter. 2 CO1 [K<sub>1</sub>]  
 c) Obtain the maximum likelihood estimator of  $\theta$  in 8 CO1 [K<sub>3</sub>]  
 $f(x; \theta) = (1 + \theta) x^\theta, 0 < x < 1.$   
 d) Let  $x_1, x_2, \dots, x_n$  be a random sample from a Poisson population with 8 CO1 [K<sub>3</sub>]  
 parameter  $\lambda$ . Estimate  $\lambda$  by the maximum likelihood estimator
2. a) A random sample of 200 tins of coconut oil gave an average weight of 4.95 2 CO2 [K<sub>2</sub>]  
 kgs, with a S.D of 0.21kg. Do we accept the net weight is 5 kgs per tin at 5%  
 level?  
 b) Give the formula for Chi-square test of independence for attributes. 2 CO3 [K<sub>2</sub>]

a	b
c	d

- c) Sandal powder is packed into packets by a machine. A random sample of 12 packets is drawn and their weight are found to be (in kg) 0.49, 0.48, 0.47, 0.48, 0.49, 0.50, 0.51, 0.49, 0.48, 0.50, 0.51 and 0.48. Test if the average weight of the packing can be taken as 0.5 kg at 5% level of significance. 8 CO2 [K<sub>3</sub>]
- d) Two sample polls of votes for two candidates A and B for a public office are taken one form among residents of rural areas. The results are given below. Examine whether the nature of the area is related to voting preference in the election. using chi-square test. 8 CO3 [K<sub>3</sub>]

Area / Votes for	A	B	Total
Rural	620	380	1000
Urban	550	450	1000
Total	1170	830	2000

3. a) List the properties of residuals. 2 CO4 [K<sub>1</sub>]
- b) From the data relating to the yield of dry bark(X<sub>1</sub>), height (X<sub>2</sub>) and girth (X<sub>3</sub>) for 18 cinchona plants, the following correlation coefficients were obtained:  $r_{12} = 0.77$ ,  $r_{13} = 0.72$ ,  $r_{23} = 0.52$ . Find the value of partial correlation coefficient. 2 CO4 [K<sub>2</sub>]
- c) Fit a parabola, by the method of least squares to the following data; also estimate  $y$  at  $x = 6$ . 8 CO4 [K<sub>3</sub>]

x :	1	2	3	4	5
y :	5	12	26	60	97

- d) Find the regression equation of  $X_1$  on  $X_2$  and  $X_3$  given the following data 8 CO4 [K<sub>3</sub>]

	$X_1$	$X_2$	$X_3$
Mean	28.02	4.91	594
Standard Deviation	4.42	1.10	85

And  $r_{12} = 0.80$ ,  $r_{13} = -0.56$  and  $r_{23} = -0.40$ .

4. a) Define random vector and random matrix. 2 CO6 [K<sub>1</sub>]
- b) Explain principal components. 2 CO6 [K<sub>2</sub>]

- c) If  $\Sigma = \begin{pmatrix} 4 & 1 & 2 \\ 1 & 9 & -3 \\ 2 & -3 & 25 \end{pmatrix}$ , then find the standard deviation matrix

$V^{1/2}$  and  $\rho$ .

- d) Compute the principal components to the following matrix

$$\Sigma = \begin{pmatrix} 1 & 4 \\ 4 & 100 \end{pmatrix}.$$

**Answer any ONE Question  
PART B (1\*20 = 20 Marks)**

5. a) State the basic principles of design of experiments. 2 CO5 [K<sub>1</sub>]  
 b) Write down the ANOVA table for Latin square design. 2 CO5 [K<sub>1</sub>]  
 c) The following data represent the number of units of production per day turned out by different workers using 4 different types of machines. 16 CO5 [K<sub>3</sub>]

		Machine Type			
		A	B	C	D
Workers	1	44	38	47	36
	2	46	40	52	43
	3	34	36	44	32
	4	43	38	46	33
	5	38	42	49	39

- (1) Test whether the five men differ with respect to mean productivity and  
 (2) Test whether the mean productivity is the same for the four different machine types.

OR

6. a) State any two advantages of a completely randomized experimental design. 2 CO5 [K<sub>1</sub>]  
 b) Write down the ANOVA table for randomized block design. 2 CO5 [K<sub>1</sub>]  
 c) In a Latin square experiment given below are the yields in quintals per acre on the paddy crop carried out for testing the effect of five fertilizers A, B, C, D, E. Analyze the data for variations. 16 CO5 [K<sub>4</sub>]

B 25	A 18	E 27	D 30	C 27
A 19	D 31	C 29	E 26	B 23
C 28	B 22	D 33	A 18	E 27
E 28	C 26	A 20	B 25	D 33
D 32	E 25	B 23	C 28	A 20

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