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Question Paper Code : 91357

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2025.

Second Semester

Civil Engineering

MA 3251 — STATISTICS AND NUMERICAL METHODS

(Common to : All Branches (Except Marine Engineering))

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

(Use of statistical tables is permitted)

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. A civil engineer wants to establish that the average time to construct a new two-storey building in less than 6 months. Formulate the null and alternative hypotheses for this context. What error could be made if $\mu = 6$?
2. Write the test statistic to test the difference of means of two samples taken from the same population whose standard deviation is not known.
3. What is the possible issue to occur if instead of using an ANOVA to compare 10 groups multiple t-tests are performed?
4. In a study, subjects are randomly assigned to one of the three groups: Control, Experimental A or Experimental B. After treatment the mean scores for three groups are to be compared. What is the type of statistical test to be performed for this comparison? Why?
5. What is the advantage of applying Lagrange interpolation method compared to Newton divided difference method?
6. Write the convergence criteria for Newton Raphson method.
7. Given $f(0) = -2$ and $f(2) = 8$. Find the root of the Newton's interpolating polynomial equation $f(x) = 0$.
8. State Trapezoidal and Simpsons $\frac{1}{3}$ rule.
9. Write the difference between single step and multi step method.
10. Write the Milne's predictor corrector formula.

PART B — (5 × 16 = 80 marks)

11. (a) (i) A chemical engineer wants to show that the mean product volumes of catalyst 1 and 2 are different. Test the following data with $\alpha = 0.05$.

Catalyst 1	0.63	2.64	1.85	1.68	1.09	1.67	0.73	1.04	0.68
Catalyst 2	3.71	4.09	4.11	3.75	3.49	3.27	3.72	3.49	4.26

- (ii) A mechanist is expected to make engine parts with axle diameter of 1.75 cm. A random sample of 10 parts shows a mean diameter 1.85 cm. with standard deviation of 0.1 cm. On the basis of this sample, would you say that the work of the mechanist is inferior?

Or

- (b) (i) Samples of three kinds of materials, subjected to extreme temperature changes, produced the results shown in the following table:

	Material A	Material B	Material C	Total
Crumbled	41	27	22	90
Remained intact	79	53	78	210
Total	120	80	100	300

Use the 0.05 level of significance to test whether, under the stated conditions, the probability of crumbling is the same for the three kinds of materials.

- (ii) Fit a binomial distribution for the following data and also the goodness of fit.

$x:$	0	1	2	3	4	5	6
Frequency $f:$	5	18	28	12	7	6	4

12. (a) An experiment was performed to determine the effect of four different chemicals on the strength of a fabric. The data are shown in Table given below. Test for differences in means using an ANOVA with $\alpha = 0.01$.

Chemical type	Fabric Sample				
	1	2	3	4	5
1	1.3	1.6	0.5	1.2	1.1
2	2.2	2.4	0.4	2.0	1.8
3	1.8	1.7	0.6	1.5	1.3
4	3.9	4.4	2.0	4.1	3.4

Or

- (b) Analyse the variance in the following Latin Square of yields (in kgs) of paddy where A, B, C, D denote the different methods of cultivation

D122	A121	C123	B122
B124	C123	A122	D125
A120	B119	D120	C121
C122	D123	B121	A122

Examine whether the different methods of cultivation have given significantly different yields.

13. (a) (i) Apply Gauss elimination method to solve the equations $x + 4y - z = -5$, $x + y - 6z = -12$, $3x - y - z = 4$.
- (ii) Solve by Jacobi's iteration method, the equations $20x + y - 2z = 17$, $3x + 20y - z = -18$, $2x - 3y + 20z = 25$.

Or

- (b) Using Jacobi's method, find all eigenvalues and eigenvectors of the matrix $A = \begin{bmatrix} 1 & \sqrt{2} & 2 \\ \sqrt{2} & 3 & \sqrt{2} \\ 2 & \sqrt{2} & 1 \end{bmatrix}$.

14. (a) (i) Given the values

x	5	7	11	13	17
$f(x)$	150	392	1452	2366	5202

Evaluate $f(9)$, using Newton's divided difference formula.

- (ii) The following data gives the velocity of a particle for 20 seconds at an interval of 5 seconds. Find the initial acceleration using the entire data:

Time t (sec):	0	5	10	15	20
Velocity v (m/sec):	0	3	14	69	228

Or

- (b) (i) Given the data:

X	30	34	38	42
Y	-30	-13	3	18

Find the value of x corresponding to $y = 0$ using Lagrange interpolation method.

- (ii) A solid of revolution is formed by rotating about x-axis, the area between x-axis, the lines $x=0$ and $x=1$ and a curve passing through the points with the following co-ordinates:

x	0	0.25	0.5	0.75	1
y	1	0.9896	0.9589	0.9089	0.8415

Estimate the volume of the solid formed using Simpson's rule.

15. (a) Solve the differential equation $\frac{dy}{dx} = xy + y^2$, using Milne predictor corrector method for $x=0.4$. Given the initial value $x=0$, $y=1$. Calculate the values of y for $x=0.1$ using Euler method, for $x=0.2$ using Modified Euler method and for $x=0.3$ using R-K method of fourth order.

Or

- (b) Obtain the solution of initial value problem $\frac{dy}{dx} = x - y^2$, $y(0)=1$ using Adams-Bashforth method at $x=0.4$. To start with, calculate $y(0.1)$ using Taylor series method, $y(0.2)$ using Euler method, $y(0.3)$ using R-K method of fourth order.