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Question Paper Code : 51317

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Second Semester

Civil Engineering

MA 3251 – STATISTICS AND NUMERICAL METHODS

(Common to : All Branches (Except B.E. Marine Engineering))

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

(Use of statistical F table, T table, X table shall be permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. An airline claims that the typical flying time between two cities is 56 minutes. Formulate a test of hypotheses with the intent of establishing that the population mean flying time is different from the published time of 56 minutes.
2. Define Type 1 and Type 2 error in testing of hypothesis.
3. Compare RBD and LSD.
4. Write the advantages of two-way ANOVA over one-way ANOVA.
5. State the condition for convergence of Newton's method.
6. Verify the following system of linear equations is diagonally dominant or not.
 $x + 2y + z = 4$; $3x + 4y + 8z = 13$; $13x + 3y + z = 5$.
7. Estimate the value of y at $x = 2$ given the data points $y(0) = 0$, $y(1) = 1$ and $y(3) = 0$.
8. Write the trapezoidal rule for n -points.
9. Define single and multi step methods for solving differential equations in numerical methods.
10. State the modified Euler's formula.

PART B — (5 × 16 = 80 marks)

11. (a) (i) A certain injection administered to each of 12 patients resulted in the following increases of blood pressure:

5, 2, 8, -1, 3, 0, 6, -2, 1, 5, 0, 4

Can it be concluded that the injection will be (in general) accompanied by an increase in blood pressure? (Use 5% level of significance). (8)

- (ii) A simple sample of heights of 6400 English men has a mean of 170 cm and a standard deviation of 6.4 cm, while a simple sample of heights of 1600 Americans has a mean of 172 cm and a standard deviation of 6.3 cm. Do the data indicate that Americans are (on the average) taller than the Englishmen? (Use 1% level of significance) (8)

Or

- (b) (i) 15.5% of a random sample of 1600 undergraduates were smokers, whereas 20% of a random sample of 900 postgraduates were smokers in a state. Can we conclude that less number of undergraduates are smokers than the postgraduates? (Use 5% level of significance) (8)

- (ii) To determine whether there really is relationship between an employee's performance in the company's training program and his or her ultimate success in the job, the company takes a sample of 400 cases from its very extensive files and obtains the results shown in the following table:

		Performance in training program			
		Below average	Average	Above average	Total
Success in job (employer's rating)	Poor	23	60	29	112
	Average	28	79	60	167
	Very good	9	49	63	121
Total		60	188	152	400

Use the 0.01 level of significance to test the null hypothesis that performance in the training program and success in the job are independent. (8)

12. (a) An experiment was designed to study the performance of 4 different detergents for cleaning fuel injectors. The following 'cleanness' readings were obtained with specially designed equipment for 12 tanks of gas distributed over 3 different model of engines.

	Engine 1	Engine 2	Engine 3	Total
Detergent A	45	43	51	139
Detergent B	47	46	52	145
Detergent C	48	50	55	153
Detergent D	42	37	49	128
Total	182	176	207	565

Obtain the appropriate analysis of variance table test at the 0.01 level of significance whether there are differences in the detergents or in the engines.

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) Using Newton-Raphson method, find the real root of the equation $3x = \cos x + 1$ correct to four decimal places. (8)
- (ii) Use Gauss-Seidel iterative method to solve the following system of simultaneous equations : $9x + 4y + z = -17$; $x - 2y - 6z = 14$; $x + 6y = 4$. Perform four iterations. (8)

Or

- (b) Use the power method to find the dominant eigenvalue and eigenvector

for the matrix $\begin{bmatrix} 0 & 11 & -5 \\ -2 & 17 & -7 \\ -4 & 26 & -10 \end{bmatrix}$ with $X_0 = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$.

14. (a) (i) The population of a town is as follows :

Year	1891	1901	1911	1921	1931
Population (in Lakhs)	46	66	81	93	101

Estimate the population at the year 1925 by Newton's Backward difference formula. (8)

- (ii) Using Newton's divided difference formula, find $f'(10)$ from the following data: (8)

x	3	5	11	27	34
$f(x)$	-13	23	899	17315	35606

Or

- (b) (i) The table given below reveals the velocity ' v ' of a body during the time ' t ' specified. Find the acceleration at $t = 1.1$ (8)

t	1.0	1.1	1.2	1.3	1.4
v	43.1	47.7	52.1	56.4	60.8

- (ii) A river is 80 m wide. The depth ' y ' of the river at a distance ' x ' from one bank is given by the following table.

x	0	10	20	30	40	50	60	70	80
y	0	4	7	9	12	15	14	8	3

Find the approximate area of cross section of the river using Simpson's 1/3 rule. (8)

15. (a) Solve $\frac{dy}{dx} = \frac{1}{x+y}$, $y(0)=1$ for $x=0.5$ to $x=1$ by Runge-Kutta method of order four. Take $h=0.5$

Or

- (b) Use Milne's method to find $y(0.8)$ from $\frac{dy}{dx} = 1+y^2$ given that $y(0)=0$, $y(0.2)=0.2027$, $y(0.4)=0.4228$ and $y(0.6)=0.6841$.