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Question Paper Code : 11629

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Second Semester

Civil Engineering

MA3251 — STATISTICS AND NUMERICAL METHODS

(Common to All Branches (Except Marine Engineering))

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

(Use of Statistical Table is permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A civil engineer wants to establish that the average time to construct a new two-storey building is less than 6 months. Formulate the null and alternate hypotheses.
2. A textile fiber manufacturer is investigating a new drapery yarn, which the company claims has a mean thread elongation of 12 kilograms with a standard deviation of 1.5 kilograms. The company wishes to test the hypothesis $H_0: \mu=12$ against $H_1: \mu<12$ using a random sample of specimens. What is the type I error probability if the critical region is defined as $\bar{x} < 11.5$ kilograms?
3. Is a 2×2 Latin square design possible? Why?
4. What is design of experiment?
5. Give the geometrical interpretation of Regula Falsi method.
6. What is the sufficient condition for the convergence of iterative method of solving simultaneous equations?
7. Form the divided difference table for the following data:

x : 5 15 22

y : 7 36 160

8. Can Simpson's 1/3 rule be used for any number of data points given? Why or why not?
9. What is the difference between Euler's method and a Taylor series?
10. Why multi-step methods are called self starting methods?

PART B — (5 × 16 = 80 marks)

11. (a) (i) A trucking firm is suspicious of the claim that the average lifetime of certain tires is atleast 28,000 miles. To check the claim, the firm puts 40 of these tires on its trucks and gets a mean lifetime of 27,463 miles with a standard deviation of 1,348 miles. Test the null hypothesis $\mu = 28,000$ against the alternative hypothesis $\mu < 28,000$ at the 0.01 level of significance. (8)

- (ii) The following are the average weekly losses of worker-hours due to accidents in 10 industrial plants before and after a certain safety program was put into operation: (8)

Before : 45 73 46 124 33 57 83 34 26 17

After : 36 60 44 119 35 51 77 29 24 11

Use the 0.05 level of significance to test whether the safety program is effective.

Or

- (b) To determine whether there really is a relationship between an employee's performances 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
Success in job (employer's rating)	Poor	23	60	29
	Average	28	79	60
	Very good	9	49	63

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.

12. (a) The following table gives the number of refrigerators sold by 4 salesmen in 3 months:

Months	Salesman			
	I	II	III	IV
May	50	40	48	39
June	46	48	50	45
July	39	44	40	39

Determine whether (i) there is any difference in average sales made by the four salesmen (ii) the sales differ with respect to different months.

Or

- (b) The following is the Latin square layout of a design when 4 varieties of seeds are tested. Set up the analysis of variance table and state your conclusion.

A105	B95	C125	D115
C115	D125	A105	B105
D115	C95	B105	A115
B95	A135	D95	C115

13. (a) (i) Use the Newton-Raphson method to find the root of $x^3 - 4x - 9 = 0$. Carry out five iterations only. (8)
- (ii) Solve the following system of equations by Gauss Seidel method (8)
- $$x_1 + y_1 + z_1 = 3$$
- $$2x_1 - y_1 + 3z_1 = 16$$
- $$3x_1 + y_1 - z_1 = -3$$

Or

- (b) (i) Apply power method to find the largest eigenvalue and the corresponding eigenvector of the matrix $\begin{bmatrix} 2 & -12 \\ 1 & -5 \end{bmatrix}$. Take $\begin{bmatrix} 1 \\ 1 \end{bmatrix}$ as initial eigen vector (perform eight iterations). (8)
- (ii) Find a real root of the equation $x^3 - 2x - 5 = 0$ by fixed point iteration method (correct to three decimal places). (8)

14. (a) (i) A textile engineer recorded the tensile strength (in Newton's) of a new fibre at various temperatures during a heating test. The data is shown below:

Temperature ($^{\circ}\text{C}$) X : 5 7 11 13

Tensile Strength (N) $f(x)$: 150 392 1492 2366

Using lagrange's interpolation formula, evaluate the tensile strength at 9°C . (8)

- (ii) Using trapezoidal rule, evaluate $\int_0^1 \int_0^1 \frac{dx dy}{xy}$ by taking four sub-intervals. (8)

Or

- (b) (i) 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: (8)

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 crosssection of the river using Simpson's 1/3 rule.

- (ii) Compute $f'(0)$ and $f''(4)$ from the data. (8)

x :	0	1	2	3	4
$f(x)$:	1	2.718	7.381	20.086	54.598

15. (a) (i) Apply the Runge-Kutta method to find the approximate value of y for $x=0.1$, if $\frac{dy}{dx}=x+y$, $y=1$ where $x=0$. (8)

- (ii) Employ Taylor's method to obtain the approximate value of y at $x=0.2$ for the differential equation $\frac{dy}{dx}=2y+3e^x$, $y(0)=0$. (8)

Or

- (b) Solve the following initial value problem $\frac{dy}{dx}=yx^2-y$ using the fourth order Adams Bashforth method to predict $y(4)$. Using Euler's method to find $y(1)$, $y(2)$, $y(3)$ if $y(0)=1$.