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Question Paper Code : 81623

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Second Semester

Civil Engineering

MA 3251 — STATISTICS AND NUMERICAL METHODS

(Common to: Aeronautical Engineering/Aerospace Engineering/Automobile Engineering/Biomedical Engineering/Civil Engineering (Environmental Engineering)/Computer Science and Design/Computer Science and Engineering/Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Cyber Security)/Computer and Communication Engineering/Electrical and Electronics Engineering/Electronics Engineering (VLSI Design and Technology)/Electronics and Communication Engineering/Electronics and Instrumentation Engineering/Electronics and Telecommunication Engineering/Environmental Engineering/Geoinformatics Engineering/Industrial Engineering/Industrial Engineering and Management/Instrumentation and Control Engineering/Manufacturing Engineering/Material Science and Engineering/Mechanical Engineering/Mechanical Engineering (Sandwich)/Mechanical Engineering (Specialised in Automobile)/Mechanical Engineering (Specialised in smart Manufacturing)/Mechanical and Automation Engineering/Mechatronics Engineering/Medical Electronics/Petrochemical Engineering/Production Engineering/Robotics and Automation/Safety and Fire Engineering/Agricultural Engineering/Artificial Intelligence and Data Science/Bio Technology/ Biotechnology and Biochemical Engineering/Chemical Engineering/Chemical and Electrochemical Engineering/Computer Science and Business Systems/Fashion Technology/Food Technology/Handloom and Textile Technology/Information Technology/Petrochemical Technology/Petroleum Engineering/Pharmaceutical Technology/Plastic Technology/Textile Chemistry/Textile Technology)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

(Use of F table, T table, X table is permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define the terms Type I and Type II errors.
2. When large sample test is available, what is the need for small sample tests?

3. What is the drawback of Latin square design over randomized block design?
4. In a 2^2 factorial design, how many treatment combinations are there, and what do they represent?
5. Find an iterative formula to find the reciprocal of a number in Newton's method.
6. What is the advantage of Gauss Seidel method over Gauss Jacobi method?
7. Write the difference table for the following data

x	3	4	5
$y = f(x)$	168	120	72

8. Give the geometrical interpretation of Trapezoidal rule.
9. Give an example for single step method and multi-step method.
10. State an advantage and disadvantage of Taylor series method.

PART B — (5 × 16 = 80 marks)

11. (a) (i) A trucking firm is suspicious of the claim that the average lifetime of certain tyres is at least 28,000 miles. To check the claim, the firm puts 40 of these tyres on its trucks and gets a mean lifetime of 27,463 miles with a standard deviation of 1,348 miles. What can it conclude at 0.01 level of significance? (8)
- (ii) A manufacturer of submersible pumps claims that at most 30% of the pumps require repairs within the first 5 years of operation. If a random sample of 120 of these pumps includes 47 which required repairs within the first 5 years, test the null hypothesis $p = 0.30$ against the alternative hypothesis $p > 0.30$ at the 0.05 level of significance. (8)

Or

- (b) (i) The following is the distribution of the hourly number of trucks arriving per hour at a company's warehouse. Find the mean of this distribution, and using it (rounded to one decimal) as the parameter λ , fit a Poisson distribution. Test for goodness of fit at the 0.05 level of significance. (8)

Number of Trucks :	0	1	2	3	4	5	6	7	8
Frequency :	52	151	130	102	45	12	5	1	2

- (ii) It is desired to determine whether there is less variability in the silver plating done by Company 1 than in that done by Company 2. If independent random samples of size 12 of the two companies work yield $s_1 = 0.035$ and $s_2 = 0.0621$, test the null hypothesis $\sigma_1^2 = \sigma_2^2$ against the alternative hypothesis $\sigma_1^2 < \sigma_2^2$ at the 0.05 level of significance. (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 models of engines

	E1	E2	E3
Detergent A	45	43	51
Detergent B	47	46	52
Detergent C	48	50	55
Detergent D	42	37	49

Test whether there are difference in the

- (i) Engines and
- (ii) Detergents at the level of significance $\alpha = 1\%$.

Or

- (b) An experiment is performed to test the effect on wheat yield of three different fertilizer treatments A, B, C and of soil variations in two perpendicular directions. The Latin square table is given below where the figures show the wheat yield per unit area. Test at 1% level of significance of the hypothesis is that there is no difference between the

- (i) Fertilizers
- (ii) Soil variations
- (iii) Treatments

75 A	78 B	80 C
81 C	76 A	79 B
73 B	75 C	77 A

13. (a) (i) Find the root of $x^3 + x^2 - 1 = 0$ that lies between 0 and 1 using fixed point iteration method. (Perform 6 iterations) (8)
- (ii) Determine the dominant eigenvalue and corresponding eigenvector of $\begin{pmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{pmatrix}$ with initial vector as $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$. (Perform 8 iterations). (8)

Or

- (b) Find the inverse of $\begin{pmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 2 \end{pmatrix}$ by Gauss elimination method.

14. (a) The following table gives corresponding values of pressure and specific volume of super-heated steam :

v	2	4	6	8	10
$p = f(v)$	105	42.7	25.3	16.7	13

- (i) Estimate p when $v = 3$ and $v = 9$. (8)
- (ii) Find the rate of change of pressure with respect to volume $\frac{dp}{dv}$ when $v = 2$ and $v = 10$. (8)

Or

- (b) (i) Find $f(4)$ using Lagrange's interpolation formula from the following data. (8)

x	3	7	8
$y = f(x)$	168	120	72

- (ii) Estimate the value of $\int_1^5 f(x) dx$ using Trapezoidal rule and Simpson's $1/3^{\text{rd}}$ rule for the following : (8)

x	1	2	3	4	5
$y = f(x)$	13	50	70	80	100

15. (a) Given $\frac{dy}{dx} = x + y - xy$, $y(0) = 1$, find

- (i) $y(0.2)$ using Taylor's method (5)
- (ii) $y(0.4)$ using Euler's method (4)
- (iii) $y(0.6)$ using 4th order Runge-Kutta method. (take $h = 0.2$). (7)

Or

- (b) Find $y(1)$ using Milne's predictor - corrector method, given $\frac{dy}{dx} = x - y^2$, with $y(0) = 0$, $y(0.2) = 0.02$, $y(0.4) = 0.0795$ and $y(0.6) = 0.1762$.