Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 30236

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Second Semester

MA 3251 – STATISTICS AND NUMERICAL METHODS

(Common to: All Branches (Except Marine Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

(Permitted, F table, T table, X Table)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Type 1 and Type 2 errors in hypothesis testing.

2. A real estate agent claims that 60% of all private residences building today are 3-bedroom homes. To test this claim, a large sample of new residences is inspected; the proportion of these homes with 3 bedrooms is recorded and used as our test statistic. State the null and alternative hypotheses to be used in this test.

3. State 2^2 factorial design with example.

4. Distinguish ANOVA one-way classification and two-way classification.

5. Find the interval in which a real root of the equation $x^3+x^2-1=0$ lies.

6. What is difference between Gauss Jacobi's method and Gauss – Seidel method?

7. Define Newton's backward interpolation formula.

8. Compute the value of $\int_0^1 f(x)dx$ by using Simpson's 1/3 rule, where $f(x)$ is given by

x	0	1	2	3	4	5	6
$f(x)$	1	0.5	0.2	0.1	0.0588	0.0385	0.027

9. Why do we need numerical methods to solve differential equations?

10. State the Euler's method formula for solving differential equation $\frac{dy}{dx} = f(x, y)$ with $y(x_0) = y_0$.

PART B — (5 × 16 = 80 marks)

11. (a) The following random samples are measurements of the heat producing capacity (in millions of calories per ton) of specimens of a coal from two mines:

Mine 1 :	8,130	8,350	8,070	8,340	8,260
Mine 2 :	7,950	7,890	7,900	8,140	7,920

Use the 0.01 level of significance to test whether the difference between the means of these two samples is significant.

Or

(b) (i) To test the claim that the resistance of electric wire can be reduced by more than 0.050 ohm by alloying, 32 values obtained for standard wire yielded the mean value is 0.136 ohm and standard deviation is 0.004 ohm, and 32 values obtained for alloyed wire yielded mean value is 0.083 ohm and standard deviation is 0.005 ohm. At the 0.05 level of significance, does this support the claim? (8)

(ii) To determine whether there really is a 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				
Success in job (employer's rating)		Below average	Average	Above average	Total
	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) As part of the investigation of the collapse of the roof of a building, a testing laboratory is given all the available bolts that connected the steel structure at 3 different positions on the roof. The forces required to shear each of these bolts (coded values) are as follows :

Position 1	90	82	79	98	83	91	
Position 2	105	89	93	104	89	95	86
Position 3	83	89	80	94			

Perform an analysis of variance to test at the 0.05 level of significance whether the differences among the sample mean at the 3 positions are significance.

Or

(b) 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:

	Engine 1	Engine 2	Engine 3
Detergent A	45	43	51
Detergent B	47	46	52
Detergent C	48	50	55
Detergent D	42	37	49

Looking at the detergents as treatments and the engines as blocks, obtain the appropriate analysis of variance table and test at the 0.01 level of significance whether there are differences in the detergents or in the engines.

13. (a) (i) Find by Newton's method, the real root of the equation $3x = \cos x + 1$, correct to four decimal places. (8)

(ii) Apply Gauss elimination method to solve the equations (8)

$x + 4y - z = -5$

$x + y - 6z = -12$

$3x - y - z = 4$

Or

(b) (i) Apply the Gauss-Seidal iteration method to solve the equations (8)

$$20x+y-2z=17$$
$$3x+20y-z=-18$$
$$2x-3y+20z=25$$

(ii) Determine the largest eigen value and the corresponding eigen vector of the matrix $\begin{pmatrix} 5 & 4 \\ 1 & 2 \end{pmatrix}$ by using Power method with the initial vector $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$. (8)

14. (a) (i) From the following table, estimate the number of students who obtained marks between 40 and 45: (8)

Marks :	30-40	40-50	50-60	60-70	70-80
No. of students :	31	4	51	35	31

(ii) Find the missing term in the following table using Lagrange's interpolation (8)

x	0	1	2	3	4
y	1	3	9	–	81

Or

(b) (i) Find the value of $\cos(1.74)$ from the following table (8)

x	1.7	1.74	1.78	1.82	1.86
$\sin x$	0.9916	0.9857	0.9781	0.9691	0.9584

(ii) Apply Simpson's rule to evaluate the integral $\int_2^{2.6}\int_4^{4.4}\frac{dxdy}{xy}$ (8)

15. (a) Apply the Runge-Kutta method to find the approximate value of y for $x=0.2$, in steps of 0.1, if $\frac{dy}{dx}=x+y^2$, $y=1$, where $x=0$.

Or

(b) Given $\frac{dy}{dx}=x\left(x^2+y^2\right)e^{-x}$, $y(0)=1$ find y at x = 0.1, 0.2, 0.3 by Taylor's series method and compute $y(0.4)$ by Milne's method.