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

Question Paper Code : 80872

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

Fourth Semester

Automobile Engineering

MA 8452 – STATISTICS AND NUMERICAL METHODS

(Common to : Mechanical Engineering/Mechatronics Engineering/Production Engineering/Robotics and Automation)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Use of calculator and Statistical Tables is permitted.

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What do you mean by the terms : Errors of Type I and Type II ?

2. Write any four applications of Chi-square distribution in statistics.

3. State the model equation for a Randomized Block Design.

4. State the distinguishing feature of a 2×2 Factorial Design.

5. What is the drawback in Gauss–Elimination method? How will you rectify it?

6. Differentiate between Direct Method and Iteration Method for solving a linear system of equation.

7. Form the Newton's backward difference table for the following data.

x	1	3	5	7
y	3	12	30	60

8. Find $\frac{dy}{dx}$ at $x = 50$ from the following table data.

x	50	51	52
y	3.6840	3.7084	3.7325

9. Find $y(0.2)$ using Euler's method if $\frac{dy}{dx} = \log(x+y)$, $y(0) = 2$.

10. State Adam's–Bashforth predictor and corrector formula.

PART B — (5 × 16 = 80 marks)

11. (a) Tests of fidelity and the selectivity of 190 radio receivers produced the results as shown below:

		Fidelity		
		Low	Average	High
Selectivity	Low	6	12	32
	Average	33	61	18
	High	13	15	0

Use 0.01 level of significance to test whether there is a relationship (dependence) between fidelity and selectivity.

Or

(b) The annual salaries (in thousands of dollars) of 8 men in middle management at a given company are : 55.5, 64.8, 68.2, 70.2, 52.4, 56.8, 60.6, 72.5 while those for 6 women are : 56.2, 48.8, 58.4, 50.9, 60.2, 54.5. Let X and Y denote the salaries of the men and women respectively. Assuming normal distribution and equal standard deviation, test the null hypothesis $\mu_X = \mu_Y$ against the alternative hypothesis $\mu_X > \mu_Y$ at 5 percent level of significance.

12. (a) Connection the following table is a Latin square design of an experiment where the letters A, B, C and D represent 4 varieties of wheat, the rows T_1, T_2, T_3 and T_4 represent 4 different fertilizers and the columns account for 4 different years. The data in table are the yields for the 4 varieties of wheat measured in Kilograms per plot. It is assumed that the various sources of variation do not interact. Using a 0.05 level of significance, test the null hypothesis. There is no difference in the average yields of the 4 varieties of wheat.

	1999	2000	2001	2002
T_1	A70	B75	C68	D81
T_2	D66	A59	B55	C63
T_3	C59	D66	A39	B42
T_4	B41	C57	D39	A55

Or

(b) An experiment was performed to judge the effect of 4 different fuels and 3 different types of launchers on the range of a certain rocket. Test on the basis of the following ranges in miles, whether there is a significant effect due to different in fuels and whether there is a significant effect due to differences in launchers. Perform a two way analysis of variance at 5% level of significance.

		Fuel			
		1	2	3	4
Launcher	1	45.9	57.6	52.2	41.7
	2	46	51	50.1	38.8
	3	45.7	56.9	55.3	48.1

13. (a) (i) Using Gauss–Jordan Method, find the inverse of the matrix $\begin{pmatrix} 1 & 1 & 2 \\ 1 & 2 & 3 \\ 2 & 3 & 1 \end{pmatrix}$. (8)

(ii) Apply Gauss–Seidal method to solve the equation (8)

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

$20x + y - 2z = 17$

$3x + 20y - z = -18$.

Or

(b) Find all the eigen values and the corresponding eigen vectors of the following matrix by Jacobi's method.

$$A = \begin{bmatrix} 1 & \sqrt{2} & 2 \\ \sqrt{2} & 3 & \sqrt{2} \\ 2 & \sqrt{2} & 1 \end{bmatrix}$$

14. (a) (i) Using Lagrange's interpolation formula, find the function $f(x)$ from the following table : (8)

x	:	0	2	3	6
$f(x)$	:	659	705	729	804

(ii) Evaluate $\int_0^1 \int_0^1 \frac{1}{1+x+y} dx\, dy$ by Trapezoidal rule with $h = 0.5$ and $k = 0.25$ correct to three decimal places. (8)

Or

(b) (i) Using Newton's Backward difference interpolation polynomial, find $y'(2.2)$ and $y''(2.2)$ from the following Table : (8)

x :	1.4	1.6	1.8	2.0	2.2
y :	4.0552	4.9530	6.0496	7.3891	9.0250

(ii) Apply Simpson's $\frac{1}{3}$ Rule to evaluate the integral $\int_2^{2.6}\int_4^{4.4} \frac{dxdy}{xy}$ with $h = 0.2$ and $k = 0.3$ correct to three decimal places. (8)

15. (a) Using Runge–Kutta method of fourth order, solve

$$\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2} \text{ with } y(0) = 1 \text{ at } x = 0.2, 0.4$$

Or

(b) Find $y(0.1)$, $y(0.2)$, $y(0.3)$ from $y' = x^2 - y$, $y(0) = 1$ by using Taylor's series method and hence obtain $y(0.4)$ using Adam's–Bashforth method.
