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

# Question Paper Code : 70770

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fourth/Fifth Semester

Mechanical Engineering

MA 6452 — STATISTICS AND NUMERICAL METHODS

(Common to : Mechanical Engineering (Sandwich)/Automobile Engineering/Mechatronics Engineering (Regulations 2013))

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What are the expected frequencies of $2 \times 2$ contingency table $\begin{array}{|c|c|}\hline a & b \\ \hline c & d \\ \hline \end{array}$?

2. Write down the formula of test statistic $t$ to test the significance of difference between the means of large samples.

3. What are the uses of ANOVA?

4. What are the basic principles in the design of experiment?

5. Find the iterative formula by Newton's method for $\frac{1}{N}$, where $N$ is a positive integer.

6. What kind of an eigenvalue and eigenvector of a matrix would be obtained by Power method?

7. Specify the Newton's backward difference formulae for $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$.

8. Write down the errors in Trapezoidal and Simpson's rules of numerical integration.

9. If $y' = -y$, $y(0) = 1$ then find $y(.1)$ by Euler method.

10. What are single step and multistep methods? Give an example.

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) The mean height of two samples of 1000 and 2000 members are respectively 67.5 and 68.0 inches. Can they be regarded as drawn from the same population with standard deviation 2.5 inches at 5% level of significance? (8)

(ii) A random sample of 10 boys has the following IQ's 70, 83, 88, 95, 98, 100, 101, 107, 110 and 120. Do these data support the assumption of a population mean IQ of 100 at 5% level of significance? (8)

Or

(b) (i) Pumpkins were grown under two experimental conditions. Two random samples of 11 and 9 pumpkins show the sample standard deviations of their weights as 0.8 and 0.5 respectively. Assuming that the weight distributions are normal, test the hypothesis that the true variances are equal, against the alternative hypothesis that they are not at the 10% level of significance. (8)

(ii) Using the data given in the following table to test at the 0.01 level of significance whether a person's ability in Mathematics is independent of his/her interest in Statistics. (8)

| | | Ability in Mathematics | | |
|---|---|---|---|---|
| | | Low | Average | High |
| Interest in Statistics | Low | 63 | 42 | 15 |
| | Average | 58 | 61 | 31 |
| | High | 14 | 47 | 29 |

12. (a) The following table shows the lives in hours of four brands of electric lamps brand. (16)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *A* | 1610 | 1610 | 1650 | 1680 | 1700 | 1720 | 1800 | |
| *B* | 1580 | 1640 | 1640 | 1700 | 1750 | | | |
| *C* | 1460 | 1550 | 1600 | 1620 | 1640 | 1660 | 1740 | 1820 |
| *D* | 1510 | 1520 | 1530 | 1570 | 1600 | 1680 | | |

Perform an analysis of variance and test the homogeneity of the mean lives of the four brands of lamps.

Or

(b) Analyze the variance in the following Latin square of yields 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. (16)

13. (a) (i) Find the +ve root of $x^4 - x - 9 = 0$ using Newton method. (8)

(ii) Find the largest Eigenvalue and its corresponding Eigenvector using power method, for

$$A = \begin{pmatrix} 1 & -3 & 2 \\ 4 & 4 & -1 \\ 6 & 3 & 5 \end{pmatrix}. \quad (8)$$

Or

(b) (i) Solve by Gauss Seidel : (8)

$$5x - 2y + z = -4$$
$$x + 6y - 2z = -1$$
$$3x + y + 5z = 13.$$

(ii) Find the inverse of $A = \begin{pmatrix} 2 & 1 & 1 \\ 3 & 2 & 3 \\ 1 & 4 & 9 \end{pmatrix}$ by Gauss Jordan method. (8)

14. (a) (i) Interpolate $y(12)$, if

| $x$ : | 10 | 15 | 20 | 25 | 30 | 35 |
|---|---|---|---|---|---|---|
| $y(x)$ | 35 | 33 | 29 | 27 | 22 | 14 |

(ii) Evaluate $\int_0^1 \frac{dx}{1+x^2}$ by Simpson's (1/3) rule, dividing the range into four equal parts.

Or

(b) (i) Find $y'(1)$, if

| $x$ : | –1 | 0 | 2 | 3 |
|---|---|---|---|---|
| $y(x)$ | –8 | 3 | 1 | 12 |

(ii) Using Trapezoidal rule, evaluate $\int_1^2 \int_1^2 \frac{dx - dy}{x + y}$ with $h = k = 0.5$.

15. (a) (i) By fourth order Runge-Kutta method, find $y(0.2)$ from $\frac{dy}{dx} = y - x$, $y(0) = 2$ taking $h = 0.1$. (8)

(ii) Solve the differential equation $\frac{d^2y}{dx^2} - y = x$ with $y(0) = 0$, $y(1) = 0$ and $h = \frac{1}{4}$ by finite difference method. (8)

Or

(b) Using Taylor's series method, solve $\frac{dy}{dx} = xy + y^2$, $y(0) = 1$ at $x = 0.1, 0.2, 0.3$. Continue the solution at $x = 0.4$ by Milne's Predictor-Corrector method. (16)

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