M. Sc. 2nd Semester Examination, 2025

APPLIED MATHEMATICS

(Numerical Analysis and Statistical Methods)

PAPER — MTM-204 (CBCS)

Full Marks : 50

Time : 2 hours

Answer **all** questions

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

1. Answer any *four* questions :   2 × 4

   (*a*) Define correlation coefficient for *n* pairs of observations.

   (*b*) What is regression ? Define regression curve.

(c) A motor car covered a distance of 50 miles four times. The first time is at 50 miles per hour, the second is at 20 miles per hour, the third is 40 miles per hour and the fourth is at 40 miles per hour. Calculate the average speed and explain the choice of the average.

(d) Define the terms numerical error and data error.

(e) If $f(x) = 4x^6 - 5x$, find the percentage error in $f(x)$ at $x = 1$ if the error in x is 0.04.

(f) Find the position of a real root of $10^x + \sin x + 2x = 0$.

2. Answer any *four* questions : 4 × 4

(a) Define standard deviation of a set of observations. Explain the following

(*Continued*)

mathematically : Standard deviation may be defined as "Root-Mean-Square-Deviation from Mean". What is the relation between variance and standard deviation ?

(b) What are regression lines ? Explain why we have two regression lines and why these two lines are identical if r the correlation coefficient is $+1$ or -1.

(c) (i) Define the term "correlation" between variables. When are the variables said to be positively corelated, negatively corelated and uncorrelated ?

(ii) The mean age of a group of 100 children was 9.35 years. The mean age of 25 of them was 8.75 years and that of another 65 was 10.51 years. What was the mean age of the remainder ? $2+2$

(d) Find the solution of the differential equation

$$\frac{dy}{dx} = x^2 - y, \quad y(0) = 1$$

for $x = 0.3$ taking $h = 0.1$ and using Euler's method. Compare the result with exact solution. $3 + 1$

(e) Find the interpolating polynomial using Lagrange's formula for the following table :

x:	-1	0	2	5
$f(x)$:	9	5	3	15

(f) Evaluate $\int_0^1 \frac{x \, dx}{1 + x^2}$ by Simpson's 1/3 rule, taking 6 equal subintervals.

3. Answer any *two* questions : 8×2

(a) (i) How do you calculate standard deviation of a composite group consisting of N_1 and N_2 observations.

     (*Continued*)

(*ii*) The mean and the variance of a group of 100 observations are 6.5 and 3.0, respectively. 55 of these observations have mean 6.6 and standard deviation 1.5. Find the mean and the S.D. of the remaining 45 observations. 3 + 5

(*b*) (*i*) You are given that the variance of x is 9. The regression equations are $8x - 10y + 66 = 0$ and $40x - 18y = 214$. Find (*I*) Average values of x and y, (*II*) Correlation coefficient between the two variables, (*III*) Standard deviation of y.

(*ii*) Prove that the coefficient of correlation is the geometric mean of the coefficients of regression. 6 + 2

(*c*) Describe Newton-Raphson method to find a real root of the equation $f(x) = 0$, where $f(x)$ is continuous function of x.

Give geometrically interpretation of this method. Write down the convergence criteria of this method. $5 + 2 + 1$

(d) Compute $y(0.8)$, from the equation $\frac{dy}{dx} = xy, y(0) = 2$, taking step length $h = 0.2$, by fourth order Runge-Kutta method, correct up to three decimal places.

[Internal Assessment — 10 Marks]