DHANAMANJURI UNIVERSITY

Examination- 2025 (June)

Four-year course B.A./B.Sc. 4^{th} Semester (NEP)

Name of Programme : B.A./B.Sc. Mathematics (Honours)
Paper Type : CORE (Theory)
Paper Code : CMA-212
Paper Title : Numerical Analysis
Full Marks : 80
Pass Marks : 32 **Duration: 3 Hours**

The figures in the margin indicate full marks for the corresponding questions.

1. Choose and rewrite the correct answer for each of the following questions: **$1 \times 3 = 3$**

a) If $f(x)$ is a polynomial of n^{th} degree in x, then $\Delta^n f(x)$, the interval of differencing being unity is

i) $n!a_n$
ii) $n!h^n a_n$
iii) $n!$
iv) 0

b) In Simpson's $\left(\frac{3}{8}\right)^{th}$ rule which is applicable only when

i) n is a multiple of 3
ii) n is a multiple of 2
iii) n is a multiple of 6
iv) n is a multiple of 8

c) Order of convergence of bisection method is

i) 1
ii) 2
iii) 1.618
iv) 3

2. Write very short answer for each of the following questions: 1×6=6

a) Evaluate $\Delta \tan^{-1} x$.

b) Find the value of $\frac{\Delta}{\Delta x}[2x^{(5)}]$, the interval of differencing is h.

c) What is the degree of $f(x)$ in Simpson's $(\frac{3}{8})^{th}$ rule?

d) State Runge-Kutta method of 2^{nd} order.

e) Give the iteration scheme of Secant method.

f) Define Algorithm.

3. Write short answer for each of the following: 3×5=15

a) Prove that $e^x = (\frac{\Delta^2}{E})e^x \frac{Ee^x}{\Delta^2 e^x}$, the interval of differencing being h.

b) Obtain the piecewise linear interpolating polynomial for the function $f(x)$ defined by the following data.

x	x_0	x_1	x_2	x_3
	1	2	4	8
$f(x)$	3	7	21	73

Hence estimate $f(3)$.

c) Evaluate $\int_0^1 \frac{dx}{1+x^2}$ using Trapezoidal rule.

d) If $f(1) = 2, f(2) = 4, f(4) = 16$, then evaluate $f(3)$ using Lagrange interpolation formula.

e) Explain Runge-Kutta method of fourth order.

4. Write short answer for each of the following: 4×5=20

a) Estimate the missing term in the following table

x	1	2	3	4	5	6	7	8
$f(x)$	1	8	?	64	?	216	343	512

b) Express $y = x^3 - x - 5$ in a factorial notation and hence show that $\Delta^3 y = 6$.

c) Using Runge-Kutta method of order 2, find approximate value of y when $x = 1.1$ given $\frac{dy}{dx} = 3x + y^2$ and $y = 1.2$ when $x = 1$.

d) Determine the order of convergence of Newton-Raphson method.

e) Write the algorithm of fixed point iteration method.

5. Answer any two of the following questions: 6×2=12

a) If $f(x)$ be a polynomial of n^{th} degree in x, then prove that the n^{th} difference of $f(x)$ is constant and $\Delta^{n+1} f(x) = 0$.

b) Using the suitable interpolation formula, estimate the population for the year 1935.

Year	1911	1921	1931	1941	1951
Population	12	15	20	27	39

c) Define interpolation and hence derive Newton's interpolation formula for unequal intervals.

6. Answer any two of the following questions: 6×2=12

a) Find the first, second derivative of the function tabulated below at the point $x = 3.0$

x	3.0	3.2	3.4	3.6	3.8	4.0
$f(x)$	-14.00	-10.032	-5.296	0.256	6.672	14.000

b) By Euler's method, find an approximate value of y corresponding to $x = 1$, given that $\frac{dy}{dx} = x + y$ and $y = 1$ when $x = 0$.

c) Derive General Quadrature formula for equal intervals and hence deduce the Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule from it.

7. Answer any two of the following questions: 6×2=12

a) Solve the following system of equations by using traingularization method

$$2x + 3y + z = 9$$
$$x + 2y + 3z = 6$$
$$3x + y + 2z = 8$$

b) Describe the Regula-Falsi method for finding an approximate root of an equation $f(x) = 0$.

c) Apply Gauss-Seidal iteration method to solve the following system of equations

$$\begin{aligned} 20x + y - 2z &= 17 \\ 3x + 20y - z &= -18 \\ 2x - 3y + 20z &= 25 \end{aligned}$$