

4. (a) From the following tabulated values of x and y ,

obtain $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at $x = 1.7$. (8)

x	1.7	1.8	1.9	2.0	2.1	2.2
y	5.4739	6.0496	6.6859	7.3891	8.1662	9.0250

- (b) Approximate the value of the integral

$$\int_0^2 \frac{1}{x^3 + x + 1} dx$$

using Simpson's 3/8 rule with $n = 6$. (7)

5. (a) Given

$$\frac{dy}{dx} = 3x + \frac{y}{2}$$

where $y(0) = 1$. Find $y(0.1)$ and $y(0.2)$ with $h = 0.1$ using Runge-Kutta second order formula up to three decimal places. (8)

- (b) Find $y(2)$ from the following data using Lagrange's interpolation formula. (7)

x	0	1	3	4	5
y	0	1	81	256	625

(200)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4818

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Unique Paper Code : 2224002004

Name of the Paper : Numerical Analysis and Computational Physics

Name of the Course : B.Sc. Hons. (Physics) NEP UGCF-2022

Semester : IV / VI (GE Paper)

Duration : 2 Hours

Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **four** questions in all with question no. 1 as compulsory.

1. Attempt any **five** out of the following : (5×3=15)

(a) Given that $u = \frac{xy^3}{z^2}$

Find the relative error at $x = y = z = 1$ when the error in each of x , y , z is 0.01.

P.T.O.

- (b) Evaluate the following integral using Trapezoidal Rule with $n = 2$ correct to three decimal places.

$$\int_0^1 \frac{1}{1+x^2} dx$$

- (c) Given $\frac{dy}{dx} = e^x$ with $y(0) = 1$.

Find the value of $y(1)$ using Euler's method with $h = 0.5$.

- (d) Write the expression for the number of iterations required to achieve an accuracy ε in solving the roots of an algebraic equation using Bisection method.

Using the expression find the no. of iterations for the following function with $\varepsilon = 0.001$

$$x^3 - x - 1 = 0 \text{ in } [1, 2]$$

- (e) Given $f(x) = \sin(x)$. Construct the Taylor series approximations of order 3 at $x = \frac{\pi}{3}$.
- (f) Define the truncation and rounding errors in numerical computation.

2. (a) Using the secant method, find a real root of the following equation, correct to four decimal places.

$$f(x) = xe^x - 1 = 0$$

Take the initial approximations as 0 and 1. (8)

- (b) Derive the expression of error associated with Newton-Raphson method of solving algebraic and transcendental equations.

Under what conditions can the method fail to converge. (7)

3. (a) Given the equation $y = ax^b$ where the data of x and y is tabulated below :

x	10	20	30	40	50
y	0.91	1.51	2.04	2.51	2.96

Find the best fitted values of a and b . (8)

- (b) Form a forward difference table for the values of x and y given below.

x	1.7	1.8	1.9	2.0	2.1	2.2
y	5.4739	6.0496	6.6859	7.3891	8.1662	9.0250

Find the value of y at $x = 1.8$ using Newton's forward interpolation formula. (7)