

Serial No: 5806

Name of the Course : B.Sc. Hons.
Semester : **VI** Semester (GE Paper)
Name of the Paper : Numerical Analysis and Computational Physics
Unique Paper Code : 2224002004
S. No. of Question Paper :

Duration: 2 hours

Maximum marks: 60

Note: Attempt four questions in all with question no. 1 as compulsory.

1. Attempt any five out of the following:

5 × 3 = 15

a) Evaluate the sum $S = \sqrt{3} + \sqrt{5} + \sqrt{7}$ to 4 significant digits and find its absolute and relative error.

a. .

b) From the following table, find the area bounded by the curve and the x -axis from $x = 7.47$ to $x = 7.52$ using Simpson's $1/3$ rule.

x	7.47	7.48	7.49	7.50	7.51	7.52
$f(x)$	1.93	1.95	1.98	2.01	2.03	2.06

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

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

d) Write the formula of Secant method for solving algebraic and transcendental equations. Explain graphically.

Given $f(x) = \cos(x)$

e) Construct the Taylor series approximation of order 5 at $x = \frac{\pi}{3}$.

f) Prove that $\Delta^3 y_0 = y_3 - 3y_2 + 3y_1 - y_0$ where Δ^3 is the third order forward difference for data points (x_0, y_0) ; (x_1, y_1) ; (x_2, y_2) and (x_3, y_3) .

2.

a) Using Bisection method, find a real root of the following equation in the interval $[2, 3]$, correct to four decimal places. (8)

$$x^3 - 2x - 5 = 0$$

- 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) Find the best values of a and b so that $y = ax^b$ fits the data given in the table. (8)

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

- b) Values of x (in degrees) and $\sin(x)$ are given in the following table:

x (in degrees)	$\sin(x)$
15	0.25881
20	0.34202
25	0.42262
30	0.5
35	0.57358
40	0.64279

Determine the value of $\sin 38^\circ$ using Newton's interpolation formula. (7)

4.

- a) A rod is rotating in plane about one of its ends. The angle θ (in radians) at different times t (seconds) are given below: (8)

t (seconds)	0	0.2	0.4	0.6	0.8	1.0
θ (radians)	0.0	0.15	0.50	1.15	2.0	3.20

Find its angular velocity and angular acceleration when $t = 0.6$ seconds.

- b) Approximate the value of $\int_0^1 e^{-x} dx$ using Trapezoidal rule with $n = 10$ and verify the theoretical error bound holds for the same. (7)

5.

- a) Use Runge-Kutta fourth order method to find $y(1.2)$ and $y(1.4)$ given that (8)

$$\frac{dy}{dx} = \frac{3x + y}{x + 2y}, \quad y(1) = 1$$

- b) For the values of x and y given below, find the value of y at $x = 10$ using Lagrange interpolation. (7)

x	5	6	9	11
y	12	13	14	16