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Reg. No. :

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M.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2024.

Third Semester

Physics – Core

NUMERICAL METHODS AND
PROGRAMMING IN C++

(For those who joined in July 2021 and 2022 only)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer:

1. Find a root of the equation $xe^x = 1$.

- (a) 0.56 (b) 0.72
(c) 0.32 (d) e^{-x}

2. The application of Gauss Elimination method is to solve _____.

- (a) linear equations
(b) nonlinear equations
(c) quadratic equations
(d) none of the above

3. The bisection method is used to find the _____ of a polynomial equation.

- (a) intervals (b) roots
(c) rows (d) columns

4. Which interpolation formula is used to solve unequally spaced data?

- (a) Newton's interpolation formula
(b) Lagrange's interpolation formula
(c) Forward interpolation formula
(d) All the above

5. The truncation error in the fourth order Runge – Kutta method is of the order of _____.

- (a) h^3 (b) h^4
(c) h^2 (d) h^5

6. Laplace equation is the _____
- First order partial derivative
 - Differential partial derivative
 - Second order partial derivative
 - All the above
7. The concept of Taylor's series was formulated by _____
- Gregory Nelson
 - Newton
 - James Gregory
 - None
8. What is the difference between Simpson's $\frac{1}{3}$ rule and $\frac{3}{8}$ rule?
- interpolant is cubic polynomial
 - interpolant is variable
 - interpolant is quadratic polynomial
 - All the above
9. What is the insertion operator in C++?
- <<
 - >>
 - <
 - >

10. Unsigned numbers in C++ are _____
- negative numbers
 - non negative numbers
 - float
 - none

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Solve the following system by Gauss-Jordan method.
- $$\begin{aligned} 2x + y + z &= 10 \\ 3x + 2y + 3z &= 18 \\ x + 4y + 9z &= 16 \end{aligned}$$
- Or
- (b) Solve the equations by Gauss Elimination method.
- $$\begin{aligned} 10x_1 - x_2 + 2x_3 &= 4 \\ x_1 + 10x_2 - x_3 &= 3 \\ 2x_1 + 3x_2 + 20x_3 &= 7 \end{aligned}$$

12. (a) Certain experimental values of x and y are given below.

x 0 2 5 7

y 1 5 12 20

If $y = a_0 + a_1x$ find the approximate values of a_0 and a_1 .

Or

- (b) From the following table of values x and y obtain dy/dx for $x=1.5$ using Newton's forward difference formula.

x	1.5	2	2.5	3	3.5	4
y	3.375	7.000	13.625	24.000	38.875	59.000

13. (a) Evaluate $\int_0^1 \frac{1}{(1+x)} dx$ correct to 3 decimal places the values of x and y are tabulated as follows.

x 0 0.5 1.0

y 1 0.6667 0.5

using Trapezoidal rule.

Or

- (b) Using Simpson's 3/8 rule, evaluate $\left(\frac{1}{1+x^2}\right)$ at $h=0.5$

x 0 0.5 1 1.5 2 2.5 3

$y = \frac{1}{1+x^2}$ 1 0.8 0.5 0.307692 0.2 0.137931 0.034 0.1

14. (a) Using modified Euler's formula, solve the differential equation $y' = -y$ with the condition $y(0) = 1$, $h = 0.01$, solve the equation at $x = 0.01$, $x = 0.02$, $x = 0.03$ and $x = 0.04$.

Or

- (b) Find the solution of the differential equation $y' = y^2$ with the condition $y(0) = 1$ at $x = 0.01$. Using Taylor's series.

15. (a) Write a C++ program for charging and discharging of a condenser using Euler's method.

Or

- (b) Write a programme for radioactive decay using Runge-Kutta method.

PART C — (5 × 8 = 40 marks)

Answer ALL questions choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Find a real root of the equation $x = e^{-x}$, using the Newton Raphson method.

Or

- (b) Solve the following system by Gauss-Jordan method.

$$2x_1 + 4x_2 + x_3 = 3$$

$$3x_1 + 2x_2 - 2x_3 = -2$$

$$x_1 - x_2 + x_3 = 6$$

17. (a) From the following data calculate the difference and obtain the forward and backward difference polynomials. Interpolate at $x = 0.25$ and $x = 0.35$.

x	0.1	0.2	0.3	0.4	0.5
y	1.4	1.56	1.76	2.0	2.28

Or

- (b) Find the polynomial of degree 2 or less such that $f(0)=1$; $f(1)=33$, $f(3)=55$. Using the Newton divided difference interpolation method.
18. (a) Find the cubic polynomial which takes the following values.

$y(0)=1$, $y(1)=0$, $y(2)=1$ and $y(3)=10$.
Hence obtain $y(4)$.

Or

- (b) The velocity of the particle at a distance s from a point on its path is given by the following table. Estimate the time taken to travel 60 feet. using Simpson's $\frac{1}{3}$ rule.

x/ft	0	10	20	30	40	50	60
$V/\text{ft/sec}$	47	58	64	65	61	52	38

19. (a) Solve $\frac{dy}{dx} = yz + x$; $\frac{dz}{dx} = xz + y$. Given that $y_0 = 1$, $z_0 = -1$ for $y(0.2)$, $z(0.2)$ and $h = 0.1$.
Using Runge-Kutta method.

Or

- (b) Solve $y'' = xy' - y$; $y(0) = 3$, $y'(0) = 0$ to calculate $y(0.1)$ using Runge-Kutta method.

20. (a) Write the programme for currents in a wheatstone's bridge.

Or

- (b) Evaluate the area under the curve using Monte-Carlo method.