Reg. No. : ....

Code No. : 6394   **Sub. Code : ZPHM 34**

M.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2022.

Third Semester

Physics — Core

NUMERICAL METHODS AND PROGRAMMING
IN C++

(For those who joined in July 2021 onwards)

Time : Three hours   Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Numerical techniques more commonly involve ——————

    (a) Elimination method

    (b) Reduction method

    (c) Iterative method

    (d) Direct method

2. Which of the following is the advantage of using the Gauss Jordan method?

    (a) Additional calculations

    (b) No labour of back substitution

    (c) More operations involved

    (d) Elimination is easier

3. To get a curve of best fit the sum of squares of residuals should be

    (a) maximum   (b) minimum

    (c) infinity   (d) none of the above

4. In cubic spline, the condition for natural spline is given by ——————

    (a) $M_0 = M_{n-1}$ (b) $M_0 = M_n = M_{n+1}$

    (c) $M_0 = M_n = 0$ (d) $M_n = 2M_{n+1}$

5. The order of the error for the trapezoidal method is

    (a) h (b) h^2

    (c) h^3 (d) h^4

6. Evaluation of integral using Monte - Carlo method requires

   (a) Variables   (b) Constants

   (c) Random numbers   (d) None of the above

7. If conditions are specified at two or more points, then it is called a ———— value problem.

   (a) finite   (b) boundary

   (c) initial   (d) infinite

8. Given $\dfrac{dy}{dx} + x = 0$, $y(0) = 0$ the value of $y(1)$ using Euler's method in single step is

   (a) 0   (b) +1

   (c) −1   (d) 2

9. What is the insertion operator on C++?

   (a) <<   (b) >>

   (c) >   (d) <

10. Given Cauchy's constant $A = 1.5$ and $B = 1.5 \times 10^{-14}$, the refractive index corresponding to 6000 A° is

    (a) 1.6   (b) 1.5041

    (c) 1.7041   (d) None of the above

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).
Each answer should not exceed 250 words.

11. (a) Find a real root of the equation $x^3 - 2x - 5 = 0$.

    Or

    (b) Find a real root of $f(x) = x^3 + x^2 + x + 7 = 0$ correct to three decimal places.

12. (a) Using Lagrange's interpolation formula, find the form of the function $y(x)$ from the following table.

x	y
0	−12
1	0
3	12
4	24

    Or

    (b) Differentiate between the forward difference and backward difference in interpolation.

13. (a) Using Simpson's $\dfrac{1}{3}$-rule with $h = 1$, evaluate the integral $I = \int_{3}^{7} x^2 \log x \, dx$.

    Or

(b) Estimate the value of the integral
$$I = \int_0^{1/2} \frac{dx}{\sqrt{x}\,\sqrt{1-x}}$$ using the trapezoidal rule. What is its exact value?

14. (a) From the Taylor series for $y(x)$ find $y(0.1)$ correct to four decimal places if $y(x)$ satisfies $y' = x - y^2$ and $y(0) = 1$.

Or

(b) Write down the Jacobi's method with solution of Laplace's equation.

15. (a) Bring out the concept of header files in C++ programming.

Or

(b) Mention the least square method using linear fitting.

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 root, correct to three decimal places and lying between 0 and 0.5, of the equation $4e^{-x} \sin x - 1 = 0$.

Or

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

17. (a) The table below gives the values of $\tan x$ for $0.10 \le x \le 0.30$.

x	$y = \tan x$
0.10	0.1003
0.15	0.1511
0.20	0.2027
0.25	0.2553
0.3	0.3093

Find : $\tan 0.12$.

Or

(b) Certain corresponding values of x and $\log_{10} x$ are (300, 2.4771), (304, 2.4829), (305, 2.4843) and (307, 2.4871) Find $\log_{10} 301$.

18. (a) Calculate the first and second derivatives of the function tabulated in the preceding example at the point $x = 2.2$ and also dy/dx at $x = 2.0$.

x	y	x	y
1.0	2.7183	1.8	6.0496
1.2	3.3201	2.0	7.3891
1.4	4.0552	2.2	9.0250
1.6	4.9530		

Or

(b) Derive Simpson's $\frac{3}{8}$ -rule.

$$\int_{x_0}^{x_3} y\,dx = \frac{3}{8}h(y_0 + 3y_1 + 3y_2 + y_3) \quad \text{using this rule,}$$

evaluate $\int_{0}^{1}\frac{1}{1+x}dx$ with $h=\frac{1}{6}$. Evaluate the integral by Simpson's $\frac{1}{3}$ - rule and compare the results.

19. (a) Give the differential equation $\frac{dy}{dx} = x^2 + y$ with $y(0) = 1$, compute $y(0.02)$ using Euler's modified method.

Or

(b) Explain the Successive Over Relaxation (SOR) method with solution of Laplace's equation.

20. (a) Compare the local and global variables in C++ programming with example.

Or

(b) Write a C++ program to evaluate the currents in Wheatstone's bride using Gauss elimination method.