

QP CODE: 24044705



Reg No :

Name :

M.Sc DEGREE (CSS) EXAMINATION, OCTOBER 2024

Third Semester

CORE - PH010302 - COMPUTATIONAL PHYSICS

M.Sc PHYSICS, M.SC SPACE SCIENCE

2019 ADMISSION ONWARDS

C225809C

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

Weight 1 each.

1. Explain the method of least squares to fit a parabolic curve to a given set of data points
2. Define shift operator. How can you relate Shift operator with forward and backward difference operators?
3. Find a polynomial of degree two for the data by Newton's forward difference formula

| | | | | | | | |
|---|---|---|---|---|----|----|----|
| X | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Y | 1 | 2 | 4 | 7 | 11 | 16 | 22 |

4. Write the algorithm to find the integral of a function using Simpson's 1/3 rule?
5. Compare the error in Trapezoidal and Simpson's rules for numerical integration.
6. How do we use Runge Kutta method to solve a system of equations.
7. Explain the necessity of pivoting.
8. Explain Gauss elimination method to find the inverse of the matrix.
9. State implicit finite difference scheme for one dimensional heat equation
10. What are the applications of Monte Carlo method?

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

Weight 2 each.





11. Find the value of $y = e^x$ when $x=0.38$, given the table

| | | | | | |
|-----------|---|--------|--------|--------|--------|
| X | 0 | 0.1 | 0.2 | 0.3 | 0.4 |
| $y = e^x$ | 1 | 1.1052 | 1.2214 | 1.3499 | 1.4918 |

12. Determine the natural cubic spline through the points $(0,-1),(1,0),(2,2),(3,0)$.

13. Find the slope of the curve at $x=1$ if it passes through the points $(0,18), (1,10), (3,-18)$ and $(6,90)$.

14. Evaluate $\int_{-3}^3 \frac{x}{5+2x} dx$ using the Trapezoidal rule.

15. Solve the initial value problem $\frac{dy}{dx} = \log(x + y), y(0) = 1$ using modified Euler method and hence find $y(0.2)$.

16. Find the inverse of the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$ by Gauss- Jordan method.

17. Express $\left(\frac{\partial^2 T}{\partial x \partial y}\right)_{1,j}$ in terms of central difference approximation.

18. Write a short note on Buffon's needle problem.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight **5** each.

19. Explain the theory of least square method and hence obtain the normal equations for fitting a straight line, exponential curve and curve of the form $y = ax^b$

20. Derive the general formula for numerical integration and arrive at simpsons 3/8 rule for Numerical integration. Also write the algorithm for this method

21. Using modified Euler's method, obtain the solution of the initial value problem $y' = x + y + xy; y(0) = 1$; at $x = 0.1$, by taking $h = 0.025$.

22. Discuss Monte Carlo integration in detail

(2×5=10 weightage)

