

QP CODE: 23002671



Reg No : .....

Name : .....

**M Sc DEGREE (CSS) EXAMINATION, MARCH 2023**

**Third Semester**

Faculty of Science

**CORE - PH010302 - COMPUTATIONAL PHYSICS**

M Sc PHYSICS, M Sc SPACE SCIENCE

2019 ADMISSION ONWARDS

EFCC4432

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. Using The method of least squares fit an exponential curve of the form  $y = ab^x$  for the following data

X	0	1	2	3	4	5
y	10	21	35	59	92	200

3. Construct Newton's forward interpolation polynomial for the following data and find the value of y at  $x = 5$

X	4	6	8	10
y	1	3	8	16

4. Write the algorithm to find the integral of a function using Simpson's 1/3 rule?
5. Write the algorithm to find the integral of a function using Simpson's 3/8 rule.
6. Comment on adaptive step size Runge Kutta method.
7. Differentiate between partial and complete pivoting.





8. Briefly explain Gauss Jordan method to find the inverse of the matrix
9. Why Crank Nicolson formula is known as the implicit formula?
10. What are the advantages of Monte Carlo integration?

(8×1=8 weightage)

### Part B (Short Essay/Problems)

Answer any **six** questions.

Weight 2 each.

11. Distance covered by a cycle rider from a fixed position and time taken for the travel was noted and tabulated as shown below: Find the position-time equation for the rider using the method of least squares assuming straight-line fit and hence determine the average velocity of the rider. What was the rider's velocity when the observation was started?

Time in hr	2	3	4	5	6
Distance (km)	45	66	85	100	125

12. What is meant by cubic spline interpolation? Explain the properties of cubic spline function. Discuss its end conditions.
13. Find the value of  $\cos(1.82)$  from the following table.

x	1.7	1.74	1.78	1.82	1.86
Sin x	0.9916	0.9857	0.9781	0.9691	0.9584

14. Determine the value of  $\frac{dy}{dx}$  at the point  $x=2$  from the following data by fitting a natural cubic spline through them.  
(1, 4), (2, 12), (4, 78), (5, 143).
15. Using fourth order Runge – Kutta method, find the value of  $y(0.2)$ . Given that  $\frac{d^2y}{dx^2} + y = 0$  with  $y(0) = 1$  and  $y'(0) = 0$ .
16. Find all the eigenvalues and eigenvectors of the matrix :  $\begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}$  by Jacobi's method.
17. Write a brief note on how to evaluate integrals using Monte Carlo method





18. Why do we need random number generation?

(6×2=12 weightage)

**Part C (Essay Type Questions)**

*Answer any **two** questions.*

*Weight 5 each.*

19. Distinguish between interpolation and extrapolation. Derive Newton's forward difference and backward difference interpolation formulae.
20. Derive the general formula for numerical integration and arrive at trapezoidal rule for Numerical integration. Also write the algorithm for this method
21. Solve the initial value problem  $\frac{dy}{dx} = 3x^2 + y$ ,  $y(0)=4$  for the range  $0.1 \leq x \leq 0.5$ , using Euler's method by taking  $h=0.1$ .
22. Use the explicit formula to solve the equation  $U_t = U_{xx}$  with the conditions  $U(0, t) = U(3, t) = 0$  and  $U(x, 0) = x^2(9 - x^2)$ . With  $h=1$  and  $\Delta t = 0.5$ , tabulate the values of  $U_i^k$  for  $i = 0, 1, 2, 3$  and  $k = 0, 1, 2$ .

(2×5=10 weightage)

