21000415

QP CODE: 21000415

Reg No : .....

Name : .....

M Sc DEGREE (CSS) EXAMINATION, MARCH 2021

Third Semester

Faculty of Science

M Sc PHYSICS

CORE - PH010302 - COMPUTATIONAL PHYSICS

2019 Admission Onwards

7708401C

Time: 3 Hours Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. Explain the least square method of Curve fitting.
2. Show that, $\Delta\nabla = \nabla\Delta = \delta^2$ where ∇ is backward difference operator, Δ is forward difference operator and δ is central difference operator.
3. What is the advantage of Newtons divided difference formula over Newtons Forward difference formula?
4. Write the algorithm to find $\int_{-1}^{1} x^2 dx$ by Trapezoidal rule?
5. Compare the error in Trapezoidal and Simpson's rules for numerical integration.
6. Explain the error term in Euler's method.
7. Explain Runge Kutta fourth order method.
8. State the principle behind the Gauss-Seidel iteration method.
9. State implicit finite difference scheme for one dimensional heat equation
10. Why Schmidt method is called the explicit method?

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Fit the second-degree parabola $y = ax^2 + bx + c$ to the given data below

x	0	1	2	3	4
y	3	6	11	18	27

12. Derive Newtons forward and backward formula for interpolation.

13. A curve passes through the points (2,12), (3,45) and (4,112) . Find $\frac{dy}{dx}$ at x=2 using cubic spline method.
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14. While a train was moving at 30 m/sec, steam was cut off and brakes were applied. The velocity of the train after this is tabulated below. Determine the distance moved by train in 35 seconds using Simpson's rule of your choice.

Time (t) in seconds	0	5	10	15	20	25	30	35
Velocity (v) in meter/sec	30	24	19.3	16	13.5	11.5	10.3	8.5

15. Find the inverse of the matrix $A = \begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & 4 \\ 1 & 2 & 2 \end{bmatrix}$

16. Find the dominant eigen value and the corresponding eigen vector of the matrix : $\begin{bmatrix} 8 & 1 & 2 \\ 0 & 10 & -1 \\ 6 & 2 & 15 \end{bmatrix}$ by power method with unit vector as the initial vector.

17. Obtain the central difference approximation to $(\frac{\partial^2 T}{\partial x^2})_{i,j}$

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 Cubic spline interpolation. Discuss the end conditions.

20. A rocket is launched from the ground. Its acceleration measured at every 5 sec is tabulated below. Find the velocity and the position of the rocket at t = 40 seconds. Use the Trapezoidal rule as well as Simpson's rule and compare the results

Time (t)	0	5	10	15	20	25	30	35	40
acceleration m/s^2	40	42.8	48.3	52.5	58.5	62.6	68.4	72.2	74.5

21. Obtain numerically the solution of $y' = x^2 + y^2$; y(0) = 0.5 using Euler's modified method to find y at x=0.1 and x=0.2.

22. Using schmidt method, solve the parabolic partial differential equation $T_t = 4\ T_{xx}$, 0, subjected to the boundary conditions T(0,t) = T(8,t) = 0, t > 0 and the initial condition $T(x,0) = 4x - \frac{x^2}{2}$ using an explicit finite difference method. Carry out computations for one-time level, taking Δx =1 and Δt = 1/8.

(2×5=10 weightage)