QP CODE: 25022298

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Reg No : .....

Name : .....

M.Sc DEGREE (CSS) SPECIAL REAPPEARANCE EXAMINATION, APRIL 2025

Third Semester

M.Sc PHYSICS

CORE - PH010302 - COMPUTATIONAL PHYSICS

2019 ADMISSION ONWARDS

20D55767

Time: 3 Hours Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. Explain the procedure for fitting a curve of the form $y = ax^b$ using the method least squares.
2. Show that, $\Delta^2 = (1 + \nabla)\delta^2$ where ∇ is backward difference operator, $\Delta$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. Evaluate $\int_{-2}^{2} x^4 dx$ by using the Trapezoidal rule.
5. Compare the error in Trapezoidal and Simpson's rules for numerical integration.
6. Explain the convergence and stability considerations while solving differential equations.
7. Differentiate between partial and complete pivoting.
8. Briefly explain the theory of Jacobi's method to obtain eigen values and eigen vectors of a real symmetric matrix.
9. What are the advantages of Monte Carlo integration?
10. Discuss the requirements for random number generation.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Derive Newtons forward and backward formula for interpolation.
12. What is meant by cubic spline interpolation? Explain the properties of cubic spline function.Discuss its end conditions.

13. The following data give the corresponding values of pressure and specific volume of super heated steam. Find the rate of change of pressure with respect to volume when V=2.

Volume V	2	4	6	8	10
Pressure P	105	43	25.4	16	12.45

14. Evaluate $\int_0^2 e^{-x}dx$ using Simpson's 1/3 rule taking h = 0.25

15. Using Euler's method, solve the problem: $\frac{dy}{dx} = 1 + y^2 \ \ with \ \ y(0)$, to obtain the solution at x =0.2.

16. Using Gauss – Seidel method, Solve the system:
    6x + y + z = 20
    x + 4y – z = 6
    x - y +5z = 7

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

18. Use the explicit formula to solve the equation $U_t = U_{xx}$ with the conditions U(0, t) = U(4, t) = 0 and U(x, 0) = x(4 – x). With h =2 and l = 0.5. Tabulate the values of U_i^k for i = 0, 1, 2 and k = 0, 1.

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. Using the least square method, obtain the normal equations to fit a parabola of type $y = a + bx + cx^2$ for a given data. Hence fit a parabolic curve to the following data

X	0	1	2	3	4
Y	1	0	3	10	21

20. Derive the general formula for numerical integration and arrive atsimpson 3/8 rule for Numerical integration. Bring out the errors associated with this method.

21. Solve $y'' - (0.1)(1 - y^2)y' + y = 0$, using Fourth order Runge – Kutta method for x =0.2 correct to four decimal places with the initial conditions y(0) =1 , y'(0)=0.

22. Solve the heat equation $U_t = U_{xx}$ subject to the conditions U(x, 0) = 0, U(0, t) = 0 and U(1, t) = t. Using Crank Nicolson scheme, find the value of U(0.5, 1/8) taking successively (i) h= ½, l =1/8, (ii) h = ¼, l= 1/8. Compare the results obtained with the exact value of U (1/2, 1/8) = 0.01878. Please note h = Δx and l = Δt.

(2×5=10 weightage)