TM243149M

Reg. No :.....

Name :.....

MASTER'S DEGREE (C.S.S) EXAMINATION, NOVEMBER 2024

2023 ADMISSIONS REGULAR

SEMESTER III - CORE COURSE

PH3C10TM20 - Computational Physics

Time : 3 Hours **Maximum Weight : 30**

Part A

I. Answer any Eight questions. Each question carries 1 weight **(8x1=8)**

1. Deduce the relation between differential and average operators.
2. Find a cubic polynomial in x which takes on the values -8, 9, 16, 24, 33, 57 when x = 0, 1, 2, 3, 4, 5 respectively.
3. Find the Lagrange's Interpolation polynomial fitting the points y(1) = -3, y(3) = 6, y(4) = 30, y(6) = 132. Find y(5)?
4. Discuss the truncation and rounding off errors involved with the Numerical differentiation.
5. Mention any three practical applications of Numerical Integration in the field of calculus.
6. What are the drawbacks of Euler's method for solving ordinary differential equations?
7. What are iteration methods? List the advantages of iterative methods over conventional methods.
8. List the differences between Jacobi method and Gauss – Seidal method for finding the solution of a system of equations.
9. Obtain the finite difference approximations to first order and second order derivatives.
10. Obtain the Jacobi's iteration formula applicable to the parabolic equation, $u_t = u_{xx}$.

Part B

II. Answer any Six questions. Each question carries 2 weight **(6x2=12)**

11. Prove that hD = log (1+Δ) = -log (1-Δ) = $sinh^{-1}\mu\delta$.
12. Find for what value of x, y is the maximum using the data given below

x	-1	1	2	3
y	-21	17	12	3

13. $\frac{dy}{dx}$

From the following table of values of x and y, obtain $\frac{dy}{dx}$ for x=1.2

x	1.0	1.2	1.4	1.6	1.8	2	2.2
y	2.7183	3.3201	4.0552	4.9530	6.0496	7.3891	9.0250

14. Use Simpson's 1/3 rule to find value of $\int_1^5 f(x)\,dx$. Given

x	1	2	3	4	5
f(x)	10	50	70	80	100

15. Using Modified Euler's method, obtain the solution of the differential equation $\frac{dy}{dt} = t + \sqrt{y} = f(t,y)$ with the initial condition $y_0 = 1$ at $t_0 = 0$ for the range $0 \leq t \leq 0.6$ in steps of 0.2.

16. Solve the following system of equations by Jacobi iterative method and perform first five iterations.

$$4x_1 - x_2 - x_3 = 3$$
$$-2x_1 + 6x_2 + x_3 = 9$$
$$-x_1 + x_2 + 7x_3 = -6$$

17. Solve the Poisson equation $\nabla^2 f = 2x^2y^2$ over the square domain $0 \leq x \leq 3$ and $0 \leq y \leq 3$ with f=0 on the boundary and h=1.

18. Discuss two different computational methods used for solving heat conduction equations.

Part C

III. Answer any Two questions. Each question carries 5 weight **(2x5=10)**

19. Explain briefly the procedure of Interpolation in 2D. Tabulate the values of the function $f(x) = x^2 + y^2 - y$ for x =0, 1, 2, 3, 4 and y = 0, 1, 2, 3, 4 and compute f(2.5, 3.5).

20. Compute the values of the integral $I = \int_0^1 \frac{dx}{1+x^2}$ using Trapezoidal rule with h = 0.5, 0.25 and 0.125. Then estimate a better result using Romberg's integration.

21. Describe Jacobi's method to find the eigen values and eigen vectors of a matrix. Find all the eigenvalues and the corresponding eigen vectors of the matrix $\begin{bmatrix} 3 & 2 & 1 \\ 2 & 3 & 2 \\ 1 & 2 & 3 \end{bmatrix}$.

22. Solve the equation $u_t = u_{xx}$ subject to the conditions $u(x,0) = \sin \pi x \, , 0 \leq x \leq 1$, and $u(0,t) = u(1,t) = 0$. Compute $u(0.6 \, , 0.04)$ with Bender-Schmidt's and Crank- Nicolson formulae.