17/10/25

TM253283T

Reg. No :.....

Name :.....

MASTER'S DEGREE (C.S.S) EXAMINATION, NOVEMBER 2025

2024 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. Show that the operators μ and E commute each other.
2. Find a cubic polynomial in x which takes on the values -3, 3, 13,27, 57,107 when x = 0, 1, 2, 3, 4, 5 respectively.
3. Find the Lagrange's Interpolation polynomial fitting the points y(1) = -3, y(3) = 0, y(4) = 30, y(6) = 132. Find y(5)?
4. Discuss the relation between rounding error and the order of derivatives that appear in the differential equation in numerical computation.
5. Explain the geometrical significance of Trapezoidal rule.
6. Discuss the principle of Euler's method used for solving a differential equation.
7. Applying power method, discuss how you can obtain the smallest eigen value of a matrix.
8. State the conditions under which Jacobi's method can be used to find the eigen values of a matrix.
9. Obtain the finite difference approximations to first order and second order derivatives.
10. State the reason for calling Bender – Schmidt recurrence relation as an implicit formula.

Part B

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

11. Show that $(a) 1-\delta^2\mu^2 = (1-\delta^2/2)^2 and (b) E^{1/2} = \mu - \delta/2$.
12. Find for what value of x, y is maximum using the data given below

x	-1	1	2	3
y	-21	15	12	3

13. From the following table of values, find the first and second of the tabulated function at x= 2.2. Also $\frac{dy}{dx}$ at x=2.0

x	1.0	1.2	1.4	1.6	1,8	2.0	2.2
y	2.7183	3.3201	4.0552	4.9530	6.0496	7.3891	9.0250

14. Evaluate $\int_0^2 \frac{1}{x^3+x+1}\,dx$ with h = 0.25 with Simpson's 1/3 rule.

15. Tabulate the solution of $\frac{dy}{dt} = t+y, \quad y(0) = 1$, in the interval $0 \leq t \leq 0.4$ with h = 0.1, using Milne's predictor corrector method.

16. Using Gaussian Jordan elimination method, find the inverse of the matrix $\begin{bmatrix} 1 & 1 & 1 \\ 4 & 3 & -1 \\ 3 & 5 & 3 \end{bmatrix}$

17. State the standard five point formula for solving the Laplace equation. Also elaborate on the different iteration methods which are used to improve the accuracy of computation.

18. Apply the finite difference method to heat conduction equation to obtain the Bender-Schmidt recurrence relation.

Part C

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

19. Discuss the construction of Cubic Spline Interpolation.

20. Evaluate $I = \int_1^2 \frac{dx}{(5+3x)}$ with 3 and 6 subintervals using Simpson's (3/8) rule.

21. What is power method? Apply this method to find the largest eigen value and the associated eigen vector of the matrix $\begin{bmatrix} -2 & -2 & 3 \\ -10 & -1 & 6 \\ 10 & -2 & -9 \end{bmatrix}$

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.