

M. Sc. DEGREE END SEMESTER EXAMINATION - OCTOBER 2024**SEMESTER 3 : PHYSICS****COURSE : 21P3PHYT10 : COMPUTATIONAL PHYSICS***(For Regular 2023 Admission and Supplementary 2022/2021 Admissions)*

Duration : Three Hours

Max. Weights: 30

PART A**Answer any 8 questions****Weight: 1**

1. Write down the general expression of 2nd order linear PDE and arrive at the cases when the equation leads to elliptical, hyperbolic and parabolic type (U, CO 4)
2. How does power method works in determination of the dominant Eigen value? (U, CO 3)
3. Discuss least square method for fitting a parabola. (U, CO 1)
4. Differentiate Euler and modified Euler method (U, CO 3)
5. Comment on the statement with valid reason: In the finite difference language, a central difference approximation is better way compared to forward or backward way of representing partial derivative (say T_x) (U, CO 4)
6. Write a short note cubic spline method. (E)
7. Discuss least square method for fitting an exponential curve. (U, CO 1)
8. Discuss truncation and rounding off errors in Numerical differentiation. (U, CO 2)
9. How can one numerically obtain the lowest Eigen value of a matrix and its corresponding Eigen vector. (U, CO 3)
10. Write down the Taylor Series expansion for a function of two variable. (U, CO 1)
(1 x 8 = 8)

PART B**Answer any 6 questions****Weights: 2**

11. Integrate the function $f(x)=\sqrt{1+x^2}$ within the limit 1 to 5 using Trapezoidal rule (A, CO 2)
12. Write down the Taylor Series expansion for a function of one variable. (U, CO 1)
13. Given the set of values:

x	10	15	20	25	30	35
y	19.97	21.51	22.47	23.52	24.65	25.89

(A, CO 1)

Form the difference table and write down the values of $\Delta^2 y_{10}$, $\Delta^5 y_{10}$

14. From the following table of values of x and f(x), determine f(0.23)
x:: 0.20 0.22 0.24 0.26 0.28 0.30
f(x):: 1.6596 1.6698 1.6804 1.6912 1.7024 1.7139 (A, CO 1)
15. The velocities of a car (running on a straight road) at intervals 2 minutes are given below:
Time in min:: 0 2 4 6 8 10 12
Vel km/Hr:: 0 22 30 27 18 7 0
Apply Simpson's rule to find the distance covered by the car (A, CO 2)
16. Solve the following system of linear equation by Gauss Elimination with Pivoting: $2x + 2y + z = 6$; $4x + 2y + 3z = 4$; $x - y + z = 0$ (A, CO 3)
17. Obtain the Eigenvalues of the matrix A using Jacobi-Method. A is given as $\begin{pmatrix} 15 & 1 & 1 \\ 1 & -2 & 6 \\ 1 & 6 & 1 \end{pmatrix}$ (A, CO 3)
18. Use power method to approximate a dominant Eigenvalue and the corresponding Eigenvector of $A = \begin{bmatrix} 4 & -5 \\ 2 & 3 \end{bmatrix}$ correct to 2-significant figures (A, CO 3)

(2 x 6 = 12)

PART C
Answer any 2 questions

Weights: 5

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| 19. | Discuss Euler and estimate its leading error term. | (U, CO 3) |
| 20. | Discuss in detail Buffon's needle problem and how it can be used in the evaluation of pi. | (U, CO 4) |
| 21. | Discuss Least-Squares curve fitting procedures for fitting a straight line, parabola, power and exponential curves | (U, CO 1) |
| 22. | Discuss Simpson's 3/8 method and error associated with it. | (U, CO 2) |
| | | (5 x 2 = 10) |

OBE: Questions to Course Outcome Mapping

CO	Course Outcome Description	CL	Questions	Total Wt.
CO 1	Apply the concept of curve fitting and interpolation	A	3, 7, 10, 12, 13, 14, 20	14
CO 2	Understand the concepts of Numerical Differentiation and Integrations and should be able to develop algorithms for the same	E	8, 11, 15, 21	10
CO 3	Solve Ordinary Differential Equations and linear set of equations using numerical methods.	A	2, 4, 9, 16, 17, 18	12
CO 4	Solve Partial Differential Equations using numerical methods and understand the concepts of random numbers.	A	1, 5, 19	7

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER;