Reg. No .... Name **20P3019**

M. Sc DEGREE END SEMESTER EXAMINATION - OCT. 2020: JANUARY 2021

SEMESTER 3 : PHYSICS

COURSE : 16P3PHYT10 : COMPUTATIONAL PHYSICS

(For Regular - 2019 Admission and Supplementary - 2016/2017/2018 Admissions)

Time : Three Hours Max. Marks: 75

PART A

Answer All (1 mark each)

1. Averaging operator μ is defined as
   a) ½ $(y_{i+1/2} + y_{i-1/2})$ b) ½ $(y_{i+1/2} - y_{i-1/2})$
   c) ½ $(y_{i+1} + y_{i-1})$ d) ½ $(y_{i+1} - y_{i-1})$
2. If a polynomial of degree n has more than n zeros, then the polynomial is
   a) oscillatory b) zero everywhere c) quadratic d) not defined
3. Simpson's 1/3 rule of integration is exact for all polynomials of degree not exceeding:
   a) 1 b) 2 c) 3 d) 4
4. Single step methods are __________
   a) Euler, Adam, Milne b) Euler, RK method , Milne
   c) Euler, Modified Euler, RK method, Taylor d) Euler, Milne, Taylor
5. An example of hyperbolic PDE is
   a) Laplace equation b) heat equation c) wave equation d) none of these

(1 x 5 = 5)

PART B

Answer any 7 (2 marks each)

6. What is ψ^2 test ? Explain.
7. Show that the following relation for operators holds good:
   μ≡ sqrt(1 + δ^2/4)
8. Graphically explain trapezoidal rule of integration
9. Discuss truncation and rounding off errors in Numerical differentiation.
10. Write a short note on Simpson's 3/8 rule of integration.
11. Write Adams- Moulton formulae for predictor corrector pair.
12. Write Milne's predictor-corrector formulae.
13. Write down a linear second order PDE of the general form and mention the case when it reduces to an elliptical equation.
14. Write down a linear second order PDE of the general form and mention the case when it reduces to an parabolic equation
15. Discuss the type of stability conditions involved in explicit way of solving PDE

(2 x 7 = 14)

PART C

Answer any 4 (5 marks each)

16. Prove that Δ/ ∇ - ∇/Δ = Δ + ∇
17. Evaluate $\Delta^n(1/x)$ taking 1 as the interval of differencing.
18. From the following table find the value of dy/dx at the point x=1.0

X	1	1.1	1.2	1.3	1.4	1.5
Y	5.4680	5.6665	5.9264	6.2551	6.6601	7.1488

19. Write an algorithm to solve ODE using modified Euler method.

20. Write down the finite difference analogue of the Laplace equation in 2 dimension and arrive at the diagonal five point formula

21. Discuss weighted average implicit method of solving $u_{xx} = u_t$ PDE. State the cases when it reduces to explicit, implicit and Crank-Nicolson scheme.

(5 x 4 = 20)

PART D

Answer any 3 (12 marks each)

22.1. Derive Newton's divided difference formula. Write down the expression for the leading error term observed in this formula.

OR

2. Discuss the steps involved in obtaining the maxima and minima of a tabulated function.

23.1. Integrate the function f(x)= 1/x using Romberg's method starting with trapezoidal rule taking h=1,0.5,0.25 and 0.125. Take limits of integration 1 and 2.

OR

2. Discuss RK 4th order method.

24.1. Explain the method of finding the solution of the differential equation y′ =f(x,y) with initial condition $y(x_0) = y_0$ by Taylor's series method.

OR

2. Solve the following initial boundary value problem using an explicit finite difference method:
$T_t = T_{xx},\ 0 \leq x \leq 1.$
Given $T = \sin(\pi x)$ when $t = 0 \& T = 0$ at $x = 0$ and $x = 1$ for $t > 0$.
Examine the accuracy of the solution at $t = 0.008$ with the analytic solution
$T(x, t) = e{-}\pi 2t \sin(\pi x).$

(12 x 3 = 36)