Reg. No															

B.Tech/M.Tech(Integrated) DEGREE EXAMINATION, NOVEMBER 2023

Third Semester

21MAB206T - NUMERICAL METHODS AND ANALYSIS

(For the candidates admitted during the academic year 2022-2023 onwards)

Note:

i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40^{th} minute.

ii. **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours **Max. Marks: 75**

PART - A (20 × 1 = 20 Marks)

Answer **all** Questions

	Question	Marks	BL	CO
1.	As soon as a new value of a variable is found by iteration, it is used immediately in the following equation. This method is called (A) Gauss-Jordon Method (B) Gauss Seidal Method (C) Gauss Jacobi Method (D) Gauss elimination Method	1	1	1
2.	In solving simultaneous equations by Gauss-Jordon Method , the co-efficient matrix is reduced to (A) Diagonal Matrix (B) Null Matrix (C) Square Matrix (D) Identity Matrix	1	1	1
3.	Newton Raphson method is also called (A) Method of tangents (B) Method of chords (C) Method of bisection (D) Method of False position	1	1	1
4.	The negative root of x^3 -2x+5=0 approximately (A) root lies between 0 and 1 (B) root lies between -1 and -2 (C) the root lies between -2 and -3 (D) root lies between 1 and 2	1	1	1
5.	What is $\Delta^2 f(x)$, if $f(x) = x^2 - 3x + 1$, taking h = 1 (A) 2x+1 (B) 2x (C) 2 (D) 0	1	1	2
6.	The operator E f(x) is equivalent to (A) f(x+h) (B) f(x-h) (C) f(x-2h) (D) f(x+2h)	1	1	2
7.	With usual notation, $\delta E^{-\frac{1}{2}}$ is equal to (A) Δ (B) ∇ (C) E+1 (D) Δ+1	1	1	2
8.	The missing term in the following table using finite difference technique is	1	1	2

x	0	1	2	3	4
$f(x)$	1	3	9	-	81

(A) 30 (B) 30.7

(C) 27.5 (D) 28.8

9. Newton's backward difference formula to get the first derivative of y(x) at any x is 1 1 3

(A) $\frac{dy}{dx} = \frac{1}{h}\left[\nabla y_n + \left(\frac{2v+1}{2}\right)\nabla^2 y_n + \ldots\right]$ (B) $\frac{dy}{dx} = \frac{1}{h}\left[\nabla y_n + \left(\frac{v+1}{2}\right)\nabla^2 y_n + \ldots\right]$

(C) $\frac{dy}{dx} = \frac{1}{h}\left[\Delta y_n + \left(\frac{2v+1}{2}\right)\Delta^2 y_n + \ldots\right]$ (D) $\frac{dy}{dx} = \frac{1}{h}\left|\Delta y_0 + \left(\frac{2u-1}{2}\right)\nabla^2 y_0 + \ldots\right|$

10. Simpson's three-eight rule can be applied only when n is 1 1 3

(A) Odd (B) Even
(C) Prime (D) Multiple of 3

11. Trapezoidal rule is so called because it 1 1 3

(A) Approximates the integral by the sum of n trapezoids (B) Finds the area of the trapezoid
(C) Splits into n trapezoids (D) Gives approximate value

12. The error in Simpson's one-third rule is of order 1 1 3

(A) h^2 (B) h^4
(C) h^3 (D) h^6

13. Taylor's series method is 1 1 4

(A) single-step method (B) Multi step method
(C) Iterative method (D) Trial and error method

14. **In Runge – Kutta method of fourth order, Δy stands for** 1 1 4

(A) $\frac{1}{6}(k_1 + k_2 + k_3 + k_4)$ (B) $\frac{1}{6}(k_1 - 2k_2 + 2k_3 - k_4)$
(C) $\frac{1}{6}(2k_1 + k_2 + k_3 + 2k_4)$ (D) $\frac{1}{6}(k_1 + 2k_2 + 2k_3 + k_4)$

15. Modified Euler's algorithm to find numerical solution of a first order differential equation for m = 0, 1, 2, is 1 1 4

(A) $y_{m+1} = y_m + h\left[f\left(x_m + \frac{h}{2}, y_m + \frac{h}{2}f(x_m, y_m)\right)\right]$ (B) $y_{m+1} = y_m + \frac{h}{2}[f(x_m, y_m) + f(x_m + h, y_m + hf(x_m, y_m))]$

(C) $y_{m+1} = y_m + hf(x_m, y_m)$ (D) $y_{m+1} = y_m + \left[f\left(x_m + \frac{h}{2}\right), y_m + \frac{h}{2}f(x_m, y_m)\right]$

16. **Given $y' = x + y, y(0) = 1$, then $y(0.1)$ by Euler's method, taking h = 0.1, is** 1 1 4

(A) 1 (B) 0.2
(C) 0.1 (D) 1.1

17. Bender-Schmidt recurrence equation is valid only if 1 1 5

(A) $k = \frac{h^2}{2}$ (B) $k = \frac{ah^2}{2}$

(C) $k = \frac{2}{ah^2}$ (D) $k = \frac{2}{h^2}$

18. The equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = f(x, y)$ is also called 1 1 5

(A) Laplace equation (B) Poisson's equation
(C) One-dimensional heat equation (D) Two-dimensional heat equation

19. The error in the diagonal five point formula is _____ times the error in the standard five point formula 1 1 5

(A) 1 (B) 2

(C) 3 (D) 4

20. Bender-Schmidt scheme converges for 1 1 5

(A) $\lambda = 1$ (B) $\lambda = \frac{1}{2}$

(C) $\lambda = 3$ (D) $\lambda = \frac{3}{2}$

PART - B ($5 \times 8 = 40$ Marks)

Answer **all** Questions

Marks BL CO

21. (a) Find a positive real root of $x\,e^{x} = 2$ by using the method of false position, correct to 3 decimal places 8 2 1

(OR)

(b) **Solve the system of equations by Gauss Elimination method**

$$2x + y + 4z = 12$$
$$8x - 3y + 2z = 20$$
$$4x - 11v - z = 33$$

22. (a) Use Lagrange's formula to fit a polynomial to the data and hence find y (x=1). 8 2 2

x:	-1	0	2	3
y:	-8	3	1	12

(OR)

(b) Find the age corresponding to the annuity value of 13.6 given the table

Age (x)	30	35	40	45	50
Annuity value (y)	15.9	14.9	14.1	13.3	12.5

23. (a) **Find the value of $sec31^{\circ}$ from the following data** 8 2 3

θ (in degrees)	31	32	33	34
tanθ	0.6008	0.6249	0.6494	0.6745

(OR)

(b) Evaluate $\int_{4}^{5.2} \log_e^x \, dx$ using trapezoidal rule and Simpson's rule taking h=0.2

24. (a) Solve $\frac{dy}{dx} = x^2 - y$ given y (0) = 1. and get y (0.1) , y (0.2) by Taylor series method. 8 2 4

(OR)

(b) Using Improved Euler's method solve $\frac{dy}{dx} = y + e^x$ y (0)=0, for x=0.2, 0.4.

25. (a) Using Crank-Nicholson's scheme 8 2 5

Solve $u_{xx} = 16u_t, 0 < x < 1, t > 0$, given $u(x,0) = 0, u(0,t) = 0,\ u(1,t) = 100t$

Compute u for one step in t direction taking $h = \frac{1}{4}$.

(OR)

(b) Using Schmid's process solve $u_{xx} = 2u_t$, with the conditions $u(x,0) = \frac{1}{4}x(15 - x)$ for $0 \le x \le 12: u(0,t) = 0: u(12,t) = 9$ for $0 < t < 12$ take h=3=k.

PART - C (1 × 15 = 15 Marks)

Answer **any 1** Questions

		Marks	BL	CO
26.	Apply the fourth order Runge Kutta method to find y(0.2) given that $y' = y + xy^2$, y(0)=1, by taking h=0.1 correct to four decimal places.	15	3	4
27.	By Iteration method, solve the Laplace equation $u_{xx} + u_{yy} = 0$, over the square region, satisfying the boundary conditions. $u(0,y) = 0, 0 \le y \le 3$ $u(3,y) = 9 + y, 0 \le y \le 3$ $u(x,0) = 3x, 0 \le x \le 3$ $u(x,3) = 4x, 0 \le y \le 3$ Find the values correct to 3 decimal places	15	3	5

* * * * *