Reg. No.														

B.Tech. / M.Tech (Integrated) DEGREE EXAMINATION, JULY 2023
Third Semester

21MAB206T – NUMERICAL METHODS AND ANALYSIS
(For the candidates admitted from the academic year 2022-2023)

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 40th minute.
(ii) **Part – B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours Max. Marks: 75

PART – A (20 × 1 = 20Marks)
Answer **ALL** Questions

Q	Question	Marks	BL	CO	PO
1.	The condition for convergence for iterative methods of solving simultaneous linear equations states that the coefficient matrix is (A) Upper triangular (B) Diagonally dominant (C) Rectangular (D) Singular	1	1	1	1
2.	The positive root of the equation $e^x = 2 + x$ lies between (A) 1.1 and 1.2 (B) 1.0 and 1.1 (C) 1.2 and 1.3 (D) 1.3 and 1.4	1	1	1	1
3.	The order of convergence of N-R method is (A) 1 (B) 2 (C) 3 (D) 4	1	1	1	1
4.	In Gauss elimination method to solve $Ax=B$, we use (A) Forward substitution method (B) Indirect substitution method (C) Direct substitution method (D) Back substitution method	1	1	1	1
5.	The relation between E and ∇ is (A) $\nabla - E^{-1} = 1$ (B) $1 + \nabla = E^{-1}$ (C) $\nabla = 1 - E^{-1}$ (D) $\nabla = 1 + E^{-1}$	1	2	2	1
6.	$\Delta \tan^{-1} x =$ (A) $\tan^{-1}(x+h) - \tan^{-1} x$ (B) $\tan^{-1}(x+h) + \tan^{-1} x$ (C) $\tan^{-1} x + \tan^{-1}(x+h)$ (D) $\tan^{-1} x - \tan^{-1}(x+h)$	1	2	2	2
7.	When the values of the independent variable are not equally spaced, then we apply (A) Central difference formula (B) Newton's forward formula (C) Newton's backward formula (D) Lagrange's formula	1	2	2	1

8. The n^{th} forward difference of y are denoted by 1 1 2 1

(A) $\Delta y_{n-1} = y_n - y_{n-1}$
(B) $\Delta y_n = y_{n-1} + y_{n+1}$
(C) $\Delta y_{n-1} = y_n + y_{n-1}$
(D) $\Delta y_n = y_{n-1} + y_n$

9. The trapezoidal rule is 1 1 3 2

(A) $\frac{h}{2}\left[(y_0+y_n)+2(y_1+y_2+...+y_{n-1})\right]$
(B) $h\left[(y_0+y_n)+2(y_1+y_2+...+y_{n-1})\right]$
(C) $h\left[\left(\frac{y_0+y_n}{2}\right)+2(y_1+y_2+...+y_{n-1})\right]$
(D) $\frac{h}{2}\left[(y_0+y_n)+2(y_1+y_3+...)+4(y_2+y_4+...)\right]$

10. Simpson's 3/8 rule is applied when 1 1 3 1

(A) Number of ordinates is odd
(B) Number of ordinates is even
(C) n is multiple of three
(D) n is even

11. Newton's forward formula to get the first derivative at $x=x_0$ is 1 1 3 1

(A) $y' = \frac{1}{h}\left[\Delta^2 y_0 - \frac{\Delta^3 y_0}{2} + \frac{\Delta^5 y_0}{3} - ...\right]$
(B) $y' = \frac{1}{h}\left[\Delta y_0 - \frac{\Delta^2 y_0}{2} + \frac{\Delta^3 y_0}{3} - ...\right]$
(C) $y' = \frac{1}{h}\left[\Delta y_0 + \frac{\Delta^2 y_0}{2} + ...\right]$
(D) $y' = \frac{1}{h^2}\left[\Delta^2 y_0 - \frac{\Delta^3 y_0}{3} + \frac{\Delta^5 y_0}{3} + ...\right]$

12. The value of $\sec 31°$ from the following table is given by 1 1 3 2

θ°	31	32	33
tanθ	0.6008	0.6249	0.6494

(A) 1.3835
(B) 1.1702
(C) 1.6643
(D) 1.2901

13. Taylor's series method is 1 2 4 1

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

14. How many prior values require to predict the next value in Milne's method? 1 1 4 1

(A) 4
(B) 2
(C) 3
(D) 1

15. The modified Euler's method is based on the averages of 1 1 4 1

(A) Points
(B) Slopes
(C) Curves
(D) Both points and slopes

16. In R-K method Δy stands for 1 1 4 1

(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) $\frac{1}{6}(k_1+2k_2+2k_3+k_4)$

17. If $B^2-4AC<0$ then the second order PDE is known as 1 1 5 1

(A) Elliptic (B) Parabolic

(C) Hyperbolic (D) Poisson

18. The equation $\nabla^2 u = f(x,y)$ is called 1 1 5 1

(A) Laplace equation (B) One dimensional heat equation

(C) One dimensional wave equation (D) Poisson equation

19. $u_{ij}=\frac{1}{4}\left[u_{i-1,j-1}+u_{i+1,j+1}+u_{i+1,j-1}+u_{i-1,j+1}\right]$ 1 1 5 1

(A) Standard five point formula (B) Diagonal five point formula

(C) Explicit formula (D) Implicit formula

20. In crank Nicholson method the value of k for λ=1 is 1 1 5 1

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

(C) $k=ah$ (D) $k=h^2$

PART – B (5 × 8 = 40 Marks)

Answer **ALL** Questions

	Marks	BL	CO	PO
21. a. Find a solution of $3x+\sin x-e^x=0$ correct to 4 decimal places by Newton's method.	8	3	1	2
(OR)				
b. Solve $e^x-3x=0$ by the method of iteration.	8	3	1	2
22. a. Using Newton's forward interpolation formula find the cubic polynomial which takes the following values.	8	3	2	2

x:	0	1	2	3
f(x):	1	2	1	10

(OR)

b. Use Lagrange's interpolation formula to fit a polynomial to the data. 8 3 2 2

x:	0	1	3	4
y:	−12	0	6	12

23. a. Evaluate $\int_0^5 \frac{dx}{4x+5}$ by Simpson's 1/3 rule and hence find the value of $\log_e^5 (n=10)$. 8 3 3 3

(OR)

b. Find $y'(x)$ given 8 3 3 2

x:	0	1	2	3	4
$y(x)$:	1	1	15	40	85

24. a. Using modified Euler's method solve, given that $y' = y - x^2 + 1, y(0) = 0.5$ Find $y(0.2)$. 8 3 4 2

(OR)

b. Solve $y' = \frac{1}{2}(1+x^2)y^2; y(0)=1, y(0.1)=1.06, y(0.2)=1.12, y(0.3)=1.21$ compute $y(0.4)$. Milne's predictor corrector formula. 8 3 4 3

25. a. Find the values of the function $u(x,t)$ satisfying $\frac{\partial u}{\partial t} = 4\frac{\partial^2 u}{\partial x^2}$ and the boundary conditions $u(0,t) = 0 = u(8,t)$ *and* $u(x,0) = 4x - \frac{x^2}{2}$ at $x = i, i = 0,1,2,3,4$ *and* $t = \frac{1}{8}j;\ j = 0,1,2,3,4,5$ 8 4 5 3

(OR)

b. Solve $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}, 0 < x < 5, t > 0$ given that $u(x,0) = 20$, $u(0,t) = 0$, $u(5,t) = 100$. Compute u for one time step with h=1 by crank Nicholson method. 8 4 5 2

PART – C (1 × 15 = 15 Marks)

Answer **ANY ONE** Questions

Marks BL CO PO

26. Solve $\nabla^2 u = 0$ over a square region of side 4 satisfying boundary conditions. 15 4 5 3
   (i) $u(0,y) = 0 \quad ; \quad 0 \le y \le 4$
   (ii) $u(4,y) = 12 + y \quad ; \quad 0 \le y \le 4$
   (iii) $u(x,0) = 3x \quad ; \quad 0 \le x \le 4$
   (iv) $u(x,4) = x^2 \quad ; \quad 0 \le x \le 4$

   By dividing the square into 16 sub squares of size 1 unit.

27. Find an equation of the cubic curve which passes through the points (4, –43), (7, 83) (9,327) and (12, 1058). Hence find $f(10)$ using Newton's divided difference formula. 15 3 2 3

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