

- b. Apply Lagrange's interpolation formula to fit a polynomial to the data given below. Also, find y at $x=2$.

x	1	3	4
y	0	6	12

30. a. In a machine a slider moves along a fixed straight rod. Its distance x cms along the rod is given below for various values of time t secs. Estimate the velocity and acceleration of the slider when $t=0.3$

t (sec):	0.0	0.1	0.2	0.3	0.4	0.5
x (cm):	29.91	31.63	32.87	33.64	33.95	33.81

(OR)

- b. Apply trapezoidal and Simpson's rule to evaluate $\int_0^{\pi} \sin x dx$, by dividing the range into ten equal parts.

31. a. Given that $y' = x + x^2 y$, $y(0) = 1$. Compute $y(0.1)$ and $y(0.2)$ by applying Euler's method and R-K method of fourth order respectively.

(OR)

- b. Applying Milne's predictor-corrector method, compute $y(4.4)$, given $5xy' + y^2 - 2 = 0$, $y(4) = 1$, $y(4.1) = 1.0049$, $y(4.2) = 1.0097$, $y(4.3) = 1.0143$.

32. a. Solve $\nabla^2 u = 0$ for square region with the given boundary conditions using numerical techniques.

	20	30	
20	u_1	u_2	40
30	u_3	u_4	50
	40	50	

(OR)

- b.i. 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 $h=0.25$ using Crank-Nicholson scheme.

- ii. Solve numerically, $4u_{xx} = u_{tt}$ with the given conditions $u(0, t) = 0$, $u(4, t) = 0$, $u_t(x, 0) = 0$, $u(x, 0) = x(4 - x)$, taking $h=1$ upto $t=2$ secs.

Reg. No.

B.Tech. DEGREE EXAMINATION, MAY 2023

Fourth Semester

18MAB202T – NUMERICAL METHODS FOR ENGINEERS

(For the candidates admitted from the academic year 2018-2019 to 2021-2022)

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 & Part - C should be answered in answer booklet.

Time: 3 hours

Max. Marks: 100

PART - A (20 × 1 = 20 Marks)

Answer ALL Questions

- In fitting a straight line by the method of least squares, the error committed is given by
(A) $E = \sum y^2 - a \sum xy - b \sum y$ (B) $E = \sum y + a \sum xy - b \sum y^2$
(C) $E = \sum y^2 - a \sum x^2 y - b \sum xy$ (D) $E = \sum y^2 - a \sum xy + b \sum y$
- In solving simultaneous linear equation by Gauss-Jordan method, the co-efficient matrix is reduced to
(A) Lower triangular matrix (B) Diagonal matrix
(C) Upper triangular matrix (D) Null matrix
- Write the condition for convergence in Newton-Raphson method.
(A) $|f(x)f''(x)| > |f'(x)|^2$ (B) $|f(x)f'(x)| > |f''(x)|^2$
(C) $|f(x)f''(x)| < |f'(x)|^2$ (D) $|f(x)f'(x)|^2 > |f''(x)|$
- Power method is used to determine the
(A) Smallest eigen value (B) Positive eigen values
(C) Negative eigen value (D) Numerically largest eigen value
- The operator E is equivalent to
(A) $(1 + \Delta)^{-1}$ (B) $(1 - \Delta)^{-1}$
(C) $(1 + \nabla)^{-2}$ (D) $(1 - \nabla)^{-1}$
- The missing term in the following table using finite difference technique is

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

(A) 27 (B) 31
(C) 30 (D) 29
- Find the factorial polynomial for the equation $3x^3 - 2x^2 + 7x - 6$, by taking $h=1$.
(A) $3x^{(3)} + x^{(2)} + 8x^{(1)} + 6$ (B) $3x^{(3)} + 7x^{(2)} + 8x^{(1)} - 6$
(C) $x^{(3)} + 7x^{(2)} - 8x^{(1)} - 6$ (D) $2x^{(3)} + 7x^{(2)} + 8x^{(1)} + 6$
- The first divided difference of $y(x)$ for the arguments x_0, x_1 is given by
(A) $\frac{y_1 - y_0}{x_1 - x_0}$ (B) $\frac{y_1 + y_0}{x_1 + x_0}$
(C) $\frac{y_2 - y_0}{x_2 - x_0}$ (D) $\frac{y_2 + y_1}{x_2 + x_1}$

9. Newton's forward difference formula to get the first order derivative at $x=x_0$ is
- (A) $\frac{dy}{dx} = \frac{1}{h} \left[\nabla y_n - \frac{1}{2} \nabla^2 y_n + \frac{1}{3} \nabla^3 y_n - \dots \right]$
- (B) $\frac{dy}{dx} = \frac{1}{h} \left[\nabla y_n + \frac{1}{2} \nabla^2 y_n + \frac{1}{3} \nabla^3 y_n + \dots \right]$
- (C) $\frac{dy}{dx} = \frac{1}{h} \left[\Delta y_0 - \frac{1}{2} \Delta^2 y_0 + \frac{1}{3} \Delta^3 y_0 - \dots \right]$
- (D) $\frac{dy}{dx} = \frac{1}{h} \left[\Delta y_0 + \frac{1}{2} \Delta^2 y_0 + \frac{1}{3} \Delta^3 y_0 + \dots \right]$
10. The error in the trapezoidal rule is
- (A) $|E| < \frac{(b-a)^2}{12} h^4$
- (B) $|E| < \frac{(b-a)}{24} h^4$
- (C) $|E| < \frac{(b-a)^2}{24} h^2$
- (D) $|E| < \frac{(b-a)}{12} h^2$
11. The error in Simpson's one-third rule is of order
- (A) h^6
- (B) h^3
- (C) h^4
- (D) h^2
12. Simpson's three-eighth rule can be applied only when the number of intervals is
- (A) Multiple of 3
- (B) Even
- (C) Odd
- (D) Any number
13. Which of the following is a multi-step method?
- (A) Euler method
- (B) Adam's predictor corrector method
- (C) Taylor's method
- (D) Runge-kutta method
14. The modified Euler method is based on the averages of
- (A) Points
- (B) Slopes
- (C) Centres
- (D) Tangents
15. How many prior values are required to predict the next value in Milne's method?
- (A) 1
- (B) 2
- (C) 4
- (D) 3
16. If $y' = x + y$, $y(0) = 1$, $h = 0.2$, then the value of $y(0.2)$ using Euler's method is
- (A) 1
- (B) 2
- (C) 1.5
- (D) 1.2
17. The nature of the partial differential equation $f_{xx} - 2f_{xy} = 0$ is
- (A) Hyperbolic
- (B) Elliptic
- (C) Parabolic
- (D) Cyclic
18. The partial differential equation $\frac{\partial^2 u}{\partial x^2} = \frac{1}{\alpha^2} \frac{\partial u}{\partial t}$ is classified as
- (A) Elliptic
- (B) Parabolic
- (C) Hyperbolic
- (D) Cyclic
19. Bender-Schmidt recurrence equation is valid only if
- (A) $k = \frac{ah}{2}$
- (B) $k = \frac{a^2 h}{4}$
- (C) $k = \frac{ah^2}{3}$
- (D) $k = \frac{ah^2}{2}$

20. The partial differential equation $\nabla^2 u = f(x, y)$ is called as
- (A) Poisson equation
- (B) Laplace equation
- (C) Parabolic equation
- (D) Hyperbolic equation

PART - B (5 × 4 = 20 Marks)

Answer ANY FIVE Questions

21. Using Newton-Raphson method derive the iterative formula to find \sqrt{N} , where N is a positive integer.
22. Find the value of x and y for the following system of equation using Gauss-Elimination method.
- $$11x + 3y = 17$$
- $$2x + 7y = 16$$
23. Form the divided difference table for the following data.
- | | | | | | | |
|---|----|-----|-----|-----|------|------|
| x | 4 | 5 | 7 | 10 | 11 | 13 |
| y | 48 | 100 | 294 | 900 | 1210 | 2028 |
24. The velocity v of a particle moving in a straight line covers a distance x in time t. They are related as follows.
- | | | | | | |
|---|----|----|----|----|----|
| x | 0 | 10 | 20 | 30 | 40 |
| v | 45 | 60 | 65 | 54 | 42 |
- Estimate the time taken to traverse the distance of 40 units by Simpson's 1/3 rule.
25. Solve $\frac{dy}{dx} = x + y$, given $y(1)=0$ and get $y(1.1)$ by Taylor series method.
26. Using improved Euler method compute y at $x=0.1$ given that $\frac{dy}{dx} = y - \frac{2x}{y}$, $y(0) = 1$.
27. Solve $\frac{\partial^2 u}{\partial x^2} - 2 \frac{\partial u}{\partial t} = 0$ given $u(0, t) = 0$, $u(4, t) = 0$, $u(x, 0) = x(4 - x)$. Assume $h=1$. Estimate the values of u upto $t=5$, using Bender-Schmidt's method.

PART - C (5 × 12 = 60 Marks)

Answer ALL Questions

28. a. Fit a straight line and parabola by the method of least square for the following data and analyze which curve is more appropriate.
- | | | | | | |
|---|---|---|----|----|----|
| x | 0 | 1 | 2 | 3 | 4 |
| y | 1 | 5 | 10 | 22 | 38 |
- (OR)
- b. Solve the following system of equation by Gauss-Seidel method.
- $$4x + 2y + z = 14$$
- $$x + 5y - z = 10$$
- $$x + y + 8z = 20$$
29. a. The following table gives the marks got by 100 students in mathematics examination. Estimate how many students got more than 55 marks.
- | | | | | | |
|------------------|-------|-------|-------|-------|-------|
| Marks | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 |
| No. of students: | 25 | 35 | 22 | 11 | 7 |

(OR)