



**B.TECH DEGREE EXAMINATIONS: APRIL / MAY 2023**

(Regulation 2018)

Fourth Semester

**(COMMON TO BIO / FT / TXT)**

U18MAT4102: Numerical Methods

**COURSE OUTCOMES**

- CO1:** Solve a set of algebraic equations representing steady state models formed in engineering problems.  
**CO2:** Fit smooth curves for the discrete data connected to each other or to use interpolation methods over these data tables.  
**CO3:** Find the trend information from discrete data set through numerical differentiation.  
**CO4:** Estimate integrals from discrete data through numerical methods.  
**CO5:** Predict the system dynamic behaviour through solution of ODEs modeling the system.  
**CO6:** Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions: -**

**PART A (10 x 2 = 20 Marks)**

**(Answer not more than 40 words)**

- State the condition for the convergence to solve  $\cos x = 3x - 1$  by iteration method. CO1 [K<sub>2</sub>]
  - Solve  $x + y = 2, 2x + 3y = 5$ , by Gauss elimination method. CO1 [K<sub>3</sub>]
  - Write the normal equations in fitting the parabola  $y = ax^2 + bx + c$  CO2 [K<sub>2</sub>]
  - Find the divided difference table for the following data: CO2 [K<sub>2</sub>]
- |            |   |   |   |   |
|------------|---|---|---|---|
| $x$        | 1 | 2 | 7 | 8 |
| $y = f(x)$ | 1 | 5 | 5 | 4 |
- Write Newton's forward difference formula to find the derivatives  $\left(\frac{dy}{dx}\right)_{x=x_0}$  and  $\left(\frac{d^2y}{dx^2}\right)_{x=x_0}$ . CO3 [K<sub>2</sub>]
  - Evaluate  $\int_0^1 \frac{dx}{1+x}$  with  $h=0.5$  using Trapezoidal rule. CO4 [K<sub>3</sub>]
  - Write Taylor's series formula to solve  $y' = f(x, y)$  with  $y(x_0) = y_0$ . CO5 [K<sub>1</sub>]
  - Obtain the value of  $y(0.2)$  by Euler's method, given that  $\frac{dy}{dx} = x + y, y(0) = 1, h=0.2$ . CO5 [K<sub>2</sub>]
  - Classify the partial differential equation  $u_{xx} - 2u_{xy} + u_{yy} = 0$ . CO6 [K<sub>2</sub>]
  - State the standard five-point formula for solving Laplace equation  $\nabla^2 u = 0$ . CO6 [K<sub>2</sub>]

**Answer any FIVE Questions:-**  
**PART B (5 x 16 = 80 Marks)**  
**(Answer not more than 400 words)**

11. a) Compute the root of  $2x^3 - 3x - 6 = 0$ , correct to four decimal places by using Newton-Raphson's method. (8) CO1 [K4]

b) Solve the system of equations using Gauss Seidel method, correct to three decimal places.  $28x + 4y - z = 32$ ,  $2x + 17y + 4z = 35$ ,  $x + 3y + 10z = 24$ . (8) CO1 [K4]

12. a) Using Lagrange's interpolation method, compute  $y(1)$ , given (8) CO2 [K4]

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

b) Fit the straight-line trend to the following data, using the method of least squares and estimate the value of  $y$  at  $x = 2.5$ . (8) CO2 [K3]

$x$	0	1	2	3	4
$y$	1	1.8	3.3	4.5	6.3

13. a) The table gives the velocity  $v$  of a moving particle at time  $t$  seconds. Estimate the acceleration at  $t = 2$  seconds. (8) CO3 [K3]

$t$	0	2	4	6	8	10	12
$v$	4	6	16	34	60	94	136

b) Using Simpson's  $\frac{1}{3}$  rule, evaluate  $\int_0^\pi \sin x \, dx$  by dividing the range into 10 equal parts. (8) CO4 [K3]

14. Given  $y' = 1 - y$ ,  $y(0) = 0$ , compute, (16) CO5 [K4]

- (i)  $y(0.1)$  by Taylor's series method
- (ii)  $y(0.2)$  by Euler's method
- (iii)  $y(0.3)$  by Improved Euler's method and
- (iv)  $y(0.4)$  by Milne's method.

15. Solve  $u_{xx} + u_{yy} = 0$  over the square mesh of side 4 units, satisfying the following boundary conditions and compute the solution correct to two decimal places: (16) CO6 [K4]

- (i)  $u(0, y) = 0$  for  $0 \leq y \leq 4$
- (ii)  $u(4, y) = 12 + y$  for  $0 \leq y \leq 4$
- (iii)  $u(x, 0) = 3x$  for  $0 \leq x \leq 4$
- (iv)  $u(x, 4) = x^2$  for  $0 \leq x \leq 4$

16. a) Solve  $u_{xx} = 2u_t$ , given  $u(0, t) = 0$ ,  $u(4, t) = 0$ ,  $u(x, 0) = x(4 - x)$  assuming  $h = k = 1$ . Find the values of  $u$  upto  $t = 5$  by Bender-Schmidt method. (8) CO6 [K3]

b) Evaluate  $\int_1^{1.4} \int_2^{2.4} \frac{1}{xy} \, dx \, dy$ , taking  $h = k = 0.1$  using Trapezoidal rule. (8) CO4 [K4]

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