A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 54022

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2018

Fourth Semester

Civil Engineering

15UMA422 - NUMERICAL METHODS

(Common to EEE, EIE and Chemical Engineering)

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. What is the order of convergence of iteration method? CO1-R

(a) 4 (b) 3 (c) 2 (d) 1

2. What is the condition for convergence of iteration method CO1-Ana

(a) $|\varphi'(x)| > 1$ (b) $|\varphi'(x)| < 1$ (c) $|\varphi'(x)| = 1$ (d) $|\varphi'(x)| = 0$

3. The n^{th} divided differences of a polynomial of the n^{th} degree are _____ . CO2-Ana

(a) n (b) constant (c) n + 1 (d) $n^2 + 1$

4. Given the two points [a, f(a)] and [b, f(b)], the linear Lagrange's polynomial $f_1(x)$ that passes through these two points is given by CO2-Ana

(a) $f_1(x) = \frac{x-b}{a-b} f(a) + \frac{x-a}{a-b} f(b)$ (b) $f_1(x) = \frac{x-a}{a-b} f(a) + \frac{x-b}{a-b} f(b)$

(c) $f_1(x) = \frac{x}{a-b} f(a) + \frac{x}{a-b} f(b)$ (d) $f_1(x) = \frac{x-b}{a-b} f(a) + \frac{x-a}{b-a} f(b)$

5. Error in the Trapezoidal rule is of order CO3-R

(a) h (b) h (c) h^2 (d) 2

6. If I_n is the value of integral $\int_a^b f(x)dx$ using n-segment trapezoidal rule, a better estimate of the integral can be found using Richardson's extrapolation as — CO3-R

(a) $I_{2n} + \frac{I_{2n} - I_n}{15}$ (b) $I_{2n} + \frac{I_{2n} - I_n}{3}$ (c) I_{2n} (d) $I_{2n} + \frac{I_{2n} - I_n}{I_{2n}}$

7. Find y(0.1) if $y' = 1 + y$, $y(0) = 1$, by using Euler's method. CO4-R

(a) 0.9231 (b) 1.2013 (c) 1.3012 (d) 0.0001

8. The corrector formula in solving ordinary differential equation numerically is applied CO4-App

(a) Correct the value (b) Improve the value (c) Modify the value (d) Adjust the value

9. $u_{i,j}^{(n+1)} = \frac{1}{4}\left(u_{i+1,j}^{(n)} + u_{i-1,j}^{(n+1)} + u_{i,j-1}^{(n)} + u_{i,j+1}^{(n+1)}\right)$ CO5-App

is the _____iterative formula

(a) Hyperbolic (b) Liebmann's (c) Implicit (d) Crank Nicholson

10. The partial differential equation $u_{xx} + u_{yy} = f(x,y)$ is called CO5-R

(a) Heat equation (b) Wave equation (c) Laplace equation (d) Poisson equation

PART – B (5 x 2= 10Marks)

11. What is the condition for convergence of Newton-Raphson method and order of convergence? CO1-App

12. State Newtons backward formula. CO2-App

13. Compare trapezoidal rule and Simpson's one third rule. CO3-Ana

14. State Trapezoidal Rule for single integration CO4-App

15. Write down the Leibmann iteration formula. CO5-App

PART – C (5 x 16= 80Marks)

16. (a) Find the numerically largest eigen value of $A=\begin{bmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{bmatrix}$ by power method. CO1-App (16)

Or

(b) (i) Using Gauss-elimination method, find the inverse of CO1-App (8)

$$A = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 2 & 0 \\ 3 & -1 & -4 \end{bmatrix}$$

(ii) Use Power method to estimate the largest Eigen value and CO1-App (8)

Eigen vector of the matrix A= $\begin{bmatrix} 15 & -4 & -3 \\ -10 & 12 & -6 \\ -20 & 4 & -2 \end{bmatrix}$

17. (a) Find y(40) from the following data using Lagrange's interpolation formula given that y(2) = 18, y(5) = 180, y(7) = 448, y(10) = 1210, y(12) = 2028. CO2-App (16)

Or

(b) (i) Given the values: CO2-App (8)

x	:	5	7	11	13	17
f(x)	:	150	392	1452	2366	5202

Find f (9), using Newton's divided difference formula.

(ii) Find the cubic spline approximation ,for the function given below assuming that M0=0, M2=0 CO2-App (8)

x :	1	2	3
y :	-8	-1	18

18. (a) (i) Evaluate $\int_0^{\Pi} \sin x \ dx$ by Trapezoidal rule, Simpson's 1/3 rule with n = 10 CO3-App (8)

(ii) Use the Trapezoidal rule to estimate the integral $\int_0^2 e^{x^2} \ dx$ taking the number n = 10 intervals. CO3-App (8)

Or

(b) (i) Evaluate $\int_0^1 \frac{dx}{\sqrt{1+x^4}}$, using three point Gaussian formula. CO3-App (6)

(ii) Apply Simpson's rule to compute CO3-App (10)
I = $\int_1^2 \int_1^2 \frac{dx\ dy}{x+y}$, taking four sub intervals.

19. (a) (i) Find by Taylor's series method, the values of y at x = 0.1 and CO4-E (8)
x = 0.2 to four decimal places from $\frac{dy}{dx} = x^2 y - 1, y(0) = 1$

(ii) Evaluate y (0.2) with h = 0.2 by Runge - Kutta method of CO4-E (8)
fourth order, Given y(0) = 0 for $y' = 1 + y^2$.

Or

(b) Determine the value of y(0.4) using Milne's method given CO4-E (16)
$y' = xy + y$, y(0) = 1; use Taylor series to get the values of y(0.1) , y(0.2) , y(0.3).

20. (a) Solve $u_{xx} + u_{yy} = 0$ numerically for the following mesh with CO5-App (16)
boundary conditions as shown below: $u(0,y) = 0,\ 0 \le x \le 4$;
$u(4,y) = 12 + y,\ 0 \le y \le 4$;
$u(x,0) = 3x,\ 0 \le x \le 4$;
$u(x,4) = x^2,\ 0 \le x \le 4$

Or

(b) Solve $u_{xx} + u_{yy} = -81xy,\ 0 < x < 1,\ 0 < y < 1$ given that CO5-App (16)
$u(0,y) = u(x,0) = 0,\ \ u(1,y) = u(x,1) = 100$ and $h = 1/3$.