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Question Paper Code: 94021

B.E./B.Tech. DEGREE EXAMINATION, NOV 2022

Fourth Semester

Civil Engineering

19UMA423 - Numerical Methods

(Common to Chemical Engineering)

(Regulations 2019)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

- Iteration method converges if $|g'(x)|$ _____ CO1-U
(a) >1 (b) <1 (c) $=0$ (d) >0
- Newton's method is also called method of _____ CO1-U
(a) tangents (b) slope (c) secants (d) false
- Lagrange's interpolation formula can be used for ____ interval CO2-U
(a) equal (b) unequal (c) equal and unequal (d) none of these
- Newton's divided difference formula used only for _____ intervals CO2-U
(a) equal (b) unequal (c) equal and unequal (d) none of these
- Truncation error in Trapezoidal rule is of the order _____. CO3- U
(a) h^3 (b) h^2 (c) h^4 (d) 0
- The Simpson's one third rule is approximated by _____ CO3- U
(a) parabola (b) trapezoid (c) hyperbola (d) elliptic
- Taylor Series method will be very useful to give some _____ values CO4-U
for RK, Milne's and Adam's methods
(a) initial (b) final (c) intermediate (d) two

8. In Euler's method, if h is large then it gives _____ value CO4-U
 (a) accurate (b) inaccurate (c) average (d) None of these
9. PDE of second order, if $B^2 - 4AC < 0$ then CO6-U
 (a) parabolic (b) elliptic (c) hyperbolic (d) Non homogeneous
10. The equation $u_{xx} + u_{yy} = 0$ CO5-App
 (a) elliptic (b) parabolic (c) hyperbolic (d) Non homogeneous

PART – B (5 x 2= 10Marks)

11. What do you mean by diagonally dominant? CO1-U
12. State Newtons divided difference formula CO2-U
13. Evaluate $\int_1^2 \frac{dx}{1+x^2}$ with 2 equal intervals using trapezoidal rule CO3-App
14. Using Taylor's series method find $y(0.1)$ given $y' = 1 + y$ with $y(0) = 1$ CO4-App
15. Classify $u_{xx} - 2u_{xy} + u_{yy} = 0$ CO6-U

PART – C (5 x 16= 80Marks)

16. (a) (i) Solve the equation $x^3 - 2x - 5 = 0$ using iteration method CO1-App (8)
 (ii) Solve $x + 3y + 3z = 16$, $x + 4y + 3z = 18$, $x + 3y + 4z = 19$ CO1- App (8)
 using Gauss Elimination method

Or

- (b) (i) Using Power method find numerically largest Eigen value and CO1- App (8)
 the corresponding Eigen vector of the matrix $\begin{pmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{pmatrix}$
- (ii) Solve $20x + y - 2z = 17$; $3x + 20y - z = -18$; $2x - 3y + 20z = 25$ using CO1- App (8)
 Gauss Seidal method .

17. (a) (i) Using Lagrange's interpolation formula calculate the profit in CO2-App (8)
 the year 2000 from the following data :

year	1997	1999	2001	2002
Profit (Rs.in lakhs)	43	65	159	248

- (ii) Using Newton's divided difference formula find $f(8)$ for the CO2-App (8)
 data

X	4	5	7	10	11	13
Y	48	100	294	900	1210	2028

Or

- (b) (i) Using Newton's forward interpolation formula find $f(2)$ for the following data CO2 -App (8)

X	0	5	10	15
Y	14	379	1444	3584

- (ii) Given the following table, find $f(1.5)$ using cubic spline function CO2 -App (8)

x	1	2	3
f(x)	-8	-1	18

18. (a) (i) Compute the first and second derivatives of y at $x = 4$ from CO3-App (8)

x	0	1	2	3	4
y	1	2.718	7.381	20.086	54.598

- (ii) Evaluate $\int_0^6 \frac{1}{1+x^2} dx$ with 6 equal intervals by CO3-App (8)

(a) Trapezoidal rule

(b) Simpson's $\frac{1}{3}$ rule

Or

- (b) (i) Evaluate. $\int_{-1}^1 \frac{x^2}{1+x^4} dx$ using three point Gaussian quadrature formula. CO3-App (8)

- (ii) Evaluate $\int_0^1 \int_0^1 \frac{1}{1+x+y} dx dy$ by using Simpson's rule by taking CO3-App (8)

$h=k=0.5$

19. (a) (i) Using Taylor's series method find $y(1.1)$ given $y' = x + y$ with $y(1) = 0$ CO4-App (8)

- (ii) Given $\frac{dy}{dx} = 1 + y^2$, $y(0) = 0$, $y(0.2) = 0.2027$, $y(0.4) = 0.4228$, $y(0.6) = 0.6841$ evaluate $y(0.8)$ by Adams – Bash forth Method. CO4-App (8)

Or

- (b) (i) Using R-K method of fourth order, solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ with CO4-App (8)

$y(0) = 1$ at $x = 0.2$

- (ii) Given $\frac{dy}{dx} = x^3 + y$, $y(0) = 2$, $y(0.2) = 2.443$, $y(0.4) = 2.99$, CO4-App (8)

$y(0.6) = 3.68$. Find $y(0.8)$ by Milne's Predictor & Corrector method.

20. (a) (i) Solve $\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}$, $u(0,t) = 0$, $u(1,t) = 0$, $u(x,0) = \sin\pi x$. CO5-App (8)

Take $h = 0.2$ and find the values of u up to $t = 0.1$ using Bender-Schmidt's difference equation

(ii) Using Crank-Nicholson's difference equation to solve CO5-App (8)

$\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}$, $u(0,t) = 0$, $u(1,t) = t$, $u(x,0) = 0$. compute u for one time step function with $h=0.25$.

Or

(b) Solve the Laplace equation $u_{xx} + u_{yy} = 0$ at the nine mesh points CO5- App (16) of the square given below. The values of u at the boundary are specified in the figure

0	11.1	17	19.7	18.6
0	u_1	u_2	u_3	21.9
0	u_4	u_5	u_6	21.0
0	u_7	u_8	u_9	17.0
0	8.7	12.1	12.8	9.0