KATHMANDU UNIVERSITY
End Semester Examination
January/February 2024

Marks Scored:

Level : B.E./B.Sc./B.Tech.
Year : II

27 JAN 2024

Course : MCSC 202
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date :

SECTION "A"
[10Q. × 0.5 = 5 marks]

Fill in the blank space(s) by the most appropriate word(s) or symbol(s).

1. Order of convergence of Newton-Raphson method is _____.

2. Significant digit of the number 02470.0 is _____.

3. In the interpolation, the process of finding the value of x from the corresponding value of $y = f(x)$is called a(n) _____ interpolation.

4. LU-decomposition splits the system $AX = b$ into two systems: one is $LY = b$ and the other is UX = _____.

5. The Runge-Kutta method of second order has an error of order_____.

6. In solving the system of linear equations, as soon as new value of variable is determined by iteration it is used immediately, this well-known method is called _____ _____ method.

7. If $y' = x + y$ with $y(0) = 1$ and $h = 0.1$, then value of k_1 in the Fourth order Runge-Kutta method is _____.

8. If $f(2) = 6, f'(2) = -\frac{1}{2}$ and $f''(2) = 10$, then most accurate Taylor polynomial approximation of $f(2.2)$ is _____.

9. _____formula is the average of the Gauss's forward and Gauss's Backward formulas.

10. Number of zeros of polynomial of degree n is _____.

SECTION "B"
[10 Q. × 0.5 = 5 marks]

Fill in the blank space(s) by selecting the most appropriate answer from among the given ones. (Do not tick the answer)

11. Which one of following relation is correct?_____
[$\Delta = E + 1$; $\Delta = E - 1$; $\nabla = E - 1$; $\nabla = E + 1$]

12. Interpolating is the method of _____.
[interrelating, approximating; decomposing; estimating]

13. Approximation of the curve of solution by tangent in each interval is obtained by _____.
[Picard's method; Runge-Kutta Method;
Euler's method; Newton's method]

14. Trapezoidal rule gives exact value when integrand is _____.
[cubic; quadratic; linear; biquadratic]

15. Forward difference at y_n is given by _____.
[$\Delta y_n = y_n - y_{n-1}$; $\Delta y_n = y_{n+1} + y_n$;
$\Delta y_n = y_{n+1} - y_n$; $\Delta y_n = y_{n-1} - y_n$]

16. The correct relation between μ *and* δ is _____.
[$\mu = 1 + \frac{\delta^2}{4}$; $\mu = 1 - \frac{\delta^2}{4}$; $\mu = \sqrt{1 + \frac{\delta^2}{2}}$; $\mu = \sqrt{1 + \frac{\delta^2}{4}}$]

17. Necessary condition for the existence of LU decomposition is that_____
_____
[at least one of the leading minors should not have its determinant's value zero;
some of the leading minors should not have their determinant's value zero;
none of the leading minors should have its determinant's value zero;
at least one of the leading minor should have its determinant's value zero]

18. The value of $\Delta^2 y_3$is _____.
[$y_3 - 2y_2 + y_1$; $y_3 + 2y_2 - y_1$; $y_3 - 2y_2 - y_1$; $y_3 + 2y_2 + y_1$]

19. Runge Kutta second order method is used to solve _____equation.
[differential; integral; interpolating; linear]

20. In the least square method, we use _____ to find the value of unknowns.
[regression equations; normal equations;
general equations; auxiliary equations]

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SECTION "C"
[6Q. × 7 = 42 marks]

1. Bisection method fails if the equation possesses double root why? Use bisection method to find the root of the equation $x^3 = 3$ in the interval [1, 2] correct to two decimal places. [2+5]

2. Discuss fourth order Runge-Kutta method to solve an initial value problem: [2+5]

$$\frac{dy}{dx} = f(x,y), \quad y(x_0) = y_0$$

Use fourth Runge - Kutta method to solve the ordinary differential equation:
$\frac{dy}{dx} = x^2 + y^2$ at $x = 1.2$ with $h = 0.1$ and $y(x_0) = 1.5, x_0 = 1$ [2+5]

OR

Use Newton's difference forward formula to find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at $x = 1.2$ with the help of following table:

x	1	1.2	1.4	1.6	1.8	2.0	2.2
y	2.7183	3.3201	4.0552	4.9530	6.0496	7.3891	9.0250

3. A staff bus departs from Kathmandu University from rest for Ratnapark .The speed of the bus at fixed time intervals are given below. Find the distance covered in 2 hours by using Simpson's 1/3rd rule.

Time (hr)	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
Speed (km/hr)	5	12	25	30	15	32	20	50	10	0

4. State third order Lagrange's interpolation polynomial formula and use it to find $y(16)$ for the following data set:

x	5	8	10	14
y	12	15	18	20

5. Purpose of LU-decomposition is to solve the system of linear equations by changing coefficient matrix into triangular matrix but why do we need this when we have other many more methods of solving such a system? Solve the following system by using LU-decomposition method [2+5]

$$x + y + z = 9; \qquad 2x - 3y + 4z = 13; \qquad 3x + 4y + 5z = 40$$

6. What does least square method is used for? Find second degree polynomial that best fit the following data:

x	0	1	2	3	4
y	1	0	3	10	21

SECTION "D"

[4Q. × 2 = 8 marks]

7. Quadratic function satisfies the following data then find $f'(2)$ from

$$(0,\ 2),\quad (2,\ -2),\quad (3,\ -1)$$

8. Show that $\Delta - \nabla = \delta^2$.

9. If $A = \begin{bmatrix} 1 & 3 & 5 \\ 1 & 4 & 3 \\ 1 & 3 & 2 \end{bmatrix}$ then find $\|A\|_e$.

10. With the help of shifting operator find the missing term in the data set given below:

x	3	4	5	6	7
y	13	21	?	43	57

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