NUMERICAL TECHNIQUES

K1 Level Questions

UNIT I

1.. The Newton Raphson algorithm for finding the iterative formula of reciprocal of N is

A. $x_{n+1}=x_n(2-Nx_n)$
B. $x_{n+1}=x_n(2+Nx_n)$
C. $x_{n+1}=x_n(4+Nx_n)$
D. $x_{n+1}=x_n(4-Nx_n)$

2. The another name of bisection method

A. Bolzano's method

B. Newton's method

C. Method of falsi position

D. Iteratation method

3. A better and closer approximation to the root can be found by using an iterative process called

A. Newton's Raphson method

B. Bisection method

C. Regula falsi method

D. Iteration method

4. The linear equation is two solutions is

A. Two solution

B. Three variables

C. No variable

D. One variable

5. The convergence of which of the following method is sensitive to starting value?

A. Regula falsi method

B. Newton Raphson method

C. Gauss seidal method

D. None of these

6. Newton-Raphson method is used to find the root of the equation x2 - 2 = 0. If iterations are started from - 1, then iterations will be

A .Converge to -1

B. Converge to $\sqrt{2}$

C. Converge to -$\sqrt{2}$

D. No Converge

7. Double (Repeated) root of 4x3- 8x2- 3x + 9 = 0 by Newton-Raphson method is

A. 1.4

B.1.5

C.1.6

D.1.55

8.Newton –Raphson method is applicable to the solution of

A. **Both algebraic and transcental equation**
B. Both algebraic and transcental equation and also used when the roots are complex.
C. Algebraic only
D. Transcendental equation only

9.Which one of the following functions is transcendental?

A. a + be^x + csinx

B. $x^2 – 5x + 6$

C. $x^2 + 4$

D. $3x^2 + 7x$

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

A.1

B.2

C.3
D.5

UNIT II

1. $(1+\Delta)(1-\nabla) =$ ______

A. 2

B. 1

C. δ^2

D. Δ

2. Δ is called ______ operator.

A. Shift

B. Central difference

C. Forward difference

D. Backward difference

3. hD= ________

A. $\log(1-\Delta)$

B. $\log(1+\Delta)$

C. $-\log(1+\Delta)$

D. -log $(1+\nabla)$

4. The first difference of a constant is ______

A. 1

B. 3

C. 2

D. 0

5. If $\Delta f(x) = f(x+h) - f(x)$, then a constant k, Δk equals

A.1

B.0

C. f(k)-f(0)

D. f(x+k)-f(x)

6. Let h be the finite difference, then forward difference operator is defined by ____.

A. f(x) = f(x-h)

B. f(x) = f(x-h)-f(x)

C. f(x) = f(x+h)

D. f(x) = f(x+h)-f(x)

7. The value of $E\nabla =$ - - - - -

A. E

B. Δ

C. ∇

D. 1

8.The displacement operator is also known as ___________.

A. Shift operator

B. Mean operator

C. Central difference operator

D. Difference operator

9. Say True or False: $1+\Delta=(1-\nabla)^{-1}$

A. True

B. False

10. To find the derivative at the end of the table we use ______ formula.
A. Newton's forward interpolation formula
B. Newton's backward interpolation formula
C. Lagrange's interpolation formula
D. Inverse Lagrange's interpolation formula

UNIT III

1. E = _______
A. $1-\nabla$
B. $1+\Delta$
C. $(1-\nabla)^{-1}$
D. $(1+\nabla)^{-1}$

2. $(1+\Delta)(1-\nabla)$ = ______
A. 2
B. **1**
C. δ^2
D. Δ

3. The Symbol of Forward Operator is
A. Δ
B. δ^2
C. $1-\nabla$
D. None

4. If interpolation is required for the range $\frac{-1}{2} < u < \frac{1}{2}$ then we use_____

A. Bessel's formula
B. Gauss backward formula
C. Gauss forward formula
D. Stirling's formula

5. In Newton's forward interpolation formula u = __________

A. $\frac{x - x_0}{h}$

B. $\frac{x + x_0}{h}$

C. $\frac{x - x_n}{h}$

D. $\frac{x + x_n}{h}$

Answer: A

6. In Newton backward interpolation formula u = ______

A. $\frac{x - x_0}{h}$

B. $\frac{x + x_0}{h}$

C. $\frac{x - x_n}{h}$

D. $\frac{x + x_n}{h}$

Answer: C

7. Interpolation means
A. Adding new data points
B. Only aligning old data points
C. Only removing old data points
D. None of the mentioned

8. Interpolation provides a mean for estimating functions
A. At the beginning points
B. At the ending points
C. At the intermediate points
D. None of the mentioned

9. Relation between Δ and E is _______
A. $E = 1 + \Delta$
B. $E = 1 - \Delta$
C. $E = 1 + \nabla$

D. E = 1 - ∇

Answer: A

UNIT IV

1. In Simpson's 3/8 rule ,y(x) is polynomial of degree

A.1

B.2

C.3

D.4

2. Runge-Kutta method is better than Taylor's method because

A. it does not require prior calculations of higher derivatives

B. it require at most first order derivatives

C. it require prior calculations of higher derivatives

D. all the above

3.The highest order of polynomial integrand for which Simpson's 1/3 rule of integration is exact is

A. first
B. second
C. third
D. fourth

4.When does Simpson's rule give exact result

A. if the entire curve y =f(x) is itself a hyperbola.
B. **if the entire curve y =f(x) is itself a parabola**.
C. if the entire curve y =f(x) is itself a ellipse.
D. if the entire curve y =f(x) is itself a circle.

5. What is the order of error in trapezoidal formula?

A. h
B. h^3
C. $\mathbf{h^2}$
D. h^4

6.Taylor series method will be very useful to give some ______ for powerful numerical methods.

A. Initial value
B. Finial value
C. Initial starting value

D. Middle value

7. $y_{n+1} = y_n + h\, f(x_n, y_n)$ is the iterative formula for

A. Euler's method

B. Taylor's method

C. Adam's method

D. Milne's method

8. Which of the following method is called step by step method

A. Taylor's method

B. RK method

C. Milne's method

D. Newton's method

9. Simpsons one-third rule will give exact result, if the entire curve y = f(x) is itself a ______

A. Ellipse

B. Circle

C. Parabola

D. Hyperbola

10. $\int_a^b y\,dx = \frac{h}{2}(A + 2B)$ where A is _____

A. Sum of the even ordinates

B. Sum of the odd ordinates

C. Sum of the all ordinates

D. All these above

UNIT V

1. $\int_a^b y\,dx = \frac{h}{3}\left[y_1 + 4(y_2 + y_4 + ... + y_{2n}) + 2(y_3 + y_5 + ... + y_{2n-1}) + y_{2n+1}\right]$ is

A. Trapezoidal rule

B. Simpson's $\frac{1}{3}$ rd rule

C. Romberg rule

D. Simpson's 3/8 th rule

2. Whenever Trapezoidal rule is applicable, Simpson rule can be applied.

A. True

B. False

3. $\frac{1}{h^2}[\nabla^2 y_n + \nabla^3 y_n + \frac{11}{12}\nabla^4 y_n + ...]$ = _____

A. $\left(\frac{dy}{dx}\right) x = x_0$

B. $\left(\frac{d^2y}{dx^2}\right) x = x_0$

C. $\left(\frac{dy}{dx}\right) x = x_n$

D. $\left(\frac{d^2y}{dx^2}\right) x = x_n$

ANSWER : D

4. By Trapezoidal rule $\int_0^6 \frac{1}{1+x} dx$ by dividing the range into six equal parts is=

A.1.9459

B.1.9587

C.1.9666

D.2.0214

5. In Euler's method, if h is small, the method is too slow and if h is large, it gives -------- value.
   (a) Inaccurate
   (b) Accurate
   (c) Indefinable
   (d) Zero
6. The improved Euler method is based on the average of-----
   (a) Slopes
   (b) Points
   (c) Curve
   (d) None of these
7. The modified Euler method is based on the average of------
   (a) Curve

(b) Slopes

(c) Points

(d) All the above

8. Runge-kutta formulas involve the computation of f(x,y) at various points instead of calculation of-------order derivatives of f(x,y)

(a) Lower

(b) Higher

(c) Middle

(d) Neither (a) or (b)

9. Euler’s modified formula is a particular case of ------order Runge-kutta method.

(a) Third

(b) First

(c) Fourth

(d) Second

10. The numerical solution of a first order differential equation will give a result is

(a) A set of tabulated values of x and y

(b) Value of x and y

(c) Zero

(d) Both (a) and (b)

Numerical Techniques

K2 Level Questions

Unit 1

1. Using Newton-Raphson method, find a root correct to three decimal places of the equation sin x =1–x.

Answer: **0.511**

2. Using Bisection method, negative root of x3 - 4x + 9 = 0 correct to three decimal places is

Answer: **-2.706**

3. Newton-Raphson method of solution of numerical equation is not preferred when

Answer: **The graph of f(x) is nearly horizontal where it crosses the x-axis**

4. Which of the following statements applies to the bisection method used for finding roots of functions?

Answer: **Guaranteed to work for all continuous functions**

5. Which of the following method gives the comparatively faster conversion?

Answer: **Newton Raphson method**

6. In bisection method while taking the initial value for the two points which of the following condition

Answer: **Both must give the opposite sign**

7. Newton Raphson method has which of the following convergence?

Answer: **Linear convergences**

8. x^2 -3cos x+ xe is which of the following equation?

Answer: **Transcendental equation**

9. If f(x) is continuous in the interval (a, b) and f (a) and f (b) are opposite signs, the equation is f(x) =0 will have positive root is

Answer: **At least one real**

10.A linear equation is one variable has

Answer: **Only one solution**

UNIT II

1. In Newton Raphson method, the error at any stage is proportional to

ANSWER: **Square of the error .**

2.If $f(x) = x^3 - 3x^2 + x + 1 = 0$ then a root lies between

ANSWER: **1.5 and 2**

3. The another name of iteration method is

ANSWER: **Method of successive approximation**

4. $f(x) = e^{-x} - \sin^2 x$ is a
ANSWER: **Transcendental equation**

5. $E - \Delta =$

ANSWER: **1**

6. $\Delta^n x^{(n)} =$
ANSWER: **n!**
7. $\nabla y_n =$ ______
ANSWER: $y_n - y_{n-1}$

8. e^{hD} =
ANSWER: $1 + \Delta$

9. $E =$ ______
ANSWER: $1 + \Delta$

10. $\Delta^n f(x) =$ ______
ANSWER: $a_o n! h^n$

UNIT III

1.Backward substitution method is applied in
ANSWER: **Gauss Elimination method**

2. Every homogeneous system of linear equation is consistent and this solution is called ___
ANSWER: **Trivial solution**

3. The number 0.0009875 when rounded off to three significant digits
ANSWER: **0.000988**

4. If a polynomial of degree *n* has more than *n* zeros, then the polynomial is
ANSWER: **Quadratic**

5. The process of finding the values inside the interval(X0, Xn) is called

ANSWER: **Interpolation**

6. Newton forward interpolation used for

ANSWER: **Equal Intervals**

7. Taylor series method will be very useful to give some ______ for powerful numerical methods.

ANSWER: **Middle value**

8. Polynomials are the most commonly used functions

ANSWER: **Evaluate, differentiate and integrate**

9. $\Delta - \nabla$ =

ANSWER: $\Delta\nabla$

10. $\nabla y_n = \_\_\_\_\_\_$

ANSWER: $y_n - y_{n-1}$

UNIT IV

1. $\Delta(af(x) + b\phi(x)) = \_\_\_\_\_\_$

ANSWER: $a\Delta f(x) - b\Delta\phi(x)$

2. The order of the error of Simpson 1/3 rule is higher than that of Trapezoidal rule.

ANSWER: **True**

3. Match the following:

A. Newton-Raphson	1. Integration
B. Runge-kutta	2. Root finding
C. Gauss-seidel	3. Ordinary Diferential Equations
D. Simpson's Rule	4. Solution of system of Linear Equations

ANSWER: **2341**

4. Which of the following formulas is a particular case of Runge-Kutta formula of the second order?

ANSWER: **Euler's modified**

5. The order of error s the Simpson's rule for numerical integration with a step size h is

ANSWER: $\mathbf{h^4}$

6. In case of Newton Backward Interpolation Formula which equation is correct to find u?

ANSWER: **x – xn = uh**

7.Simpson's 1/3rd rule is used only when __________

ANSWER: **n is even**

8. While evaluating the definite integral by Trapezoidal rule, the accuracy can be increased by taking ___

ANSWER: **Large number of sub-intervals**

9. In application of Simpson's 1/3rd rule, the interval h for closer approximation should be ______

ANSWER: **Even**

10. While applying Simpson's 3/8 rule the number of sub intervals should be _____

ANSWER: **multiple of 3**

UNIT V

1. The numerical solution of a first order differential equation will give a result is

   ANSWER: **Value of x and y**

2. A series for y In terms of x, from which the values of y can be obtained by

   ANSWER: **Direct substitution**

3. Euler algorithm formula is also be written as

   ANSWER: **Y(x+y)=y(x)+hf(x,y)**

4. Euler's improved formula is

   ANSWER: $\mathbf{Y_{x+1}=y_x+\frac{1}{}h\{f(x_m,y_m)+f[x_m+h,y_m+hf(x_m,y_m)]\}}$

5. Euler's modified formula is

   ANSWER: $\mathbf{Y_{x+1}=y_x+h[f(x_m+\frac{1}{}\ \ ,y_m\frac{1}{}\ \ f(x_m,y_m)]}$

6. Third order Runge - Kutta method

   ANSWER: $\mathbf{\Delta y=\frac{1}{}(k_1+4k_2+k_3)}$

7. Fourth order Runge – Kutta method

   Answer: $\mathbf{\Delta y=\frac{1}{}(k_1+2k_2+2k_3+k_4)}$

8. By Trapezoidal rule $\int_0^6 \frac{1}{1+x}dx$ by dividing the range into six equal parts is=

   Answer: **2.0214**

9. $\frac{1}{h^2}[\nabla^2 y_n + \nabla^3 y_n + \frac{11}{12}\nabla^4 y_n + ...]$ = ____

$$\left(\frac{d^2y}{dx^2}\right)x = x_n$$

10 $\int_a^b ydx = \frac{h}{3}\left[y_1 + 4(y_2 + y_4 + ... + y_{2n}) + 2(y_3 + y_5 + ... + y_{2n-1}) + y_{2n+1}\right]$ is

Answer: **Simpson's** $\frac{1}{3}$ **rd rule**

Numerical Techniques

K3 Level Questions

UNIT I

1. Find a real root of the equations $x^3+x^2-100=0$.

2. Find the negative roots of the equations $x^3-2x+5=0$.

3. Determine the root of $xe^x-3=0$ correct to 3 decimal places using the method of false position.

4. Solve $x^3-x-1=0$ by using bisection method.

5. Solve $x^3-x^2-2=0$ by regular falsi method.

6. Find the root of $xe^x-2=0$ which lies between 0 and 1 to 4 decimal places by using falsi position method.

7. Find by Newton Raphson method the real root of 3x-cosx-1=0.

8. Find by Newton's method correct to 2 decimal places the negative root of the equation $x^3-21x+35=0$.

9. 2x-3sinx-5=0 correct to 6 decimal places by Newton's method

10. cosx=3x-2 solve by using the method of Iteration.

UNIT II

1. In the table below, estimate the missing value

x	0	1	2	3	4
y	1	2	4	-	16

   Explain why its differs from $2^3=8$.

2. The following data gives the melting point of an alloy of lead and zinc, where t is the temperature in deg-c and p is the percentage of lead in the alloy.

p	40	50	60	70	80	90
t	184	204	226	250	276	304

3. Using Newton's forward interpolation formula find the value of y when x=21 from the following tabulated values of the functions.

x	20	23	26	29

y	0.3420	0.3907	0.4384	0.4848

4. Using Newton's formula, find the value of f(1.5) from the following data.

x	0	1	2	3	4
f(x)	858.3	869.6	880.9	892.3	903.6

5. Using Newton's formula, find y when x=27 from the following data.

x	10	15	20	25	30
y	35.4	32.2	29.1	26.6	23.1

6. Using the polynomial of the third degree complete the record given below of the export of a certain commodity during 5 years.

Years	1917	1918	1919	1920	1921
Export	443	384	-	397	467

7. Find the missing value from the following data

x	2	4	6	8	10
Y	5.6	8.6	13.9	-	35.6

8. Find the missing value in the sequence

15.75	17.9	-	22.75	43.2

9. Derive the Equation For Newton's forward interpolation
10. Derive the Methodology of Newton Raphson method

UNIT III

1. Derive String's formula.
2. Derive the maxima and minima of the tabulated function.
3. Find dy/dx and d^2y/dx^2 at x=1.15 from the table of values of x and y

x	1.00	1.05	1.10	1.15	1.20	1.25	1.30
y	1.0000	1.02470	1.04881	1.07238	1.09544	1.11803	1.14017

4. Find the first two derivatives of $\sqrt[3]{x}$ at x=50 from the table:

x	50	51	52	53	54	55	56
$\sqrt[3]{x}$	3.6840	3.7084	3.7325	3.7563	3.7798	3.8030	3.8259

5. Find the values of cos 1.74 using the values given in the table below:

x	1.70	1.74	1.78	1.82	1.86
Sin x	0.9916	0.9857	0.9781	0.9691	0.9584

6. Using the following data, find f'(5)

x	0	2	3	4	7	9
F(x)	4	26	58	112	466	922

7. From the values in the table given below, find the values of sec 31◦ using Numerical differentiation

θ in degrees	31	32	33	34
Tanθ	0.6008	0.6249	0.6494	0.6745

Hint: d/d(tanθ)=sec$^2\theta$

8. In the following data gives corresponding values of pressure and specific volume of a superheated stream.

v	2	4	6	8	10
p	105	42.7	25.3	16.7	13

a) Find the rate of change of pressure with respect to volume when v=2.

9. The following indicate the velocity ‘v’ of a body during a time ‘t’ specified. Find its acceleration when t=1.1

t	1.0	1.1	1.2	1.3	1.4
v	43.1	47.7	52.1	56.4	60.8

10. The population of a certain town is shown in the following table

Years	1931	1941	1951	1961	1971

Population in thousand	40.62	60.80	79.95	103.56	132.65

Find the rate of growth of the population in 1961.

UNIT IV

1. Write the notes of Simpson's rule

2. Derive Romberg's method

3. Write the notes of trapezoidal rule.

4. Using the trapezoidal rule, evaluate dx from the following table:

X	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
Y	1.23	1.53	2.03	4.32	6.25	8.36	10.23	12.45

5. Use the trapezoidal rule to evaluate the integral of y(x) from o to $\frac{\Pi}{}$ from the data below.

X	0	∏/12	2∏/12	3∏/12	4∏/12	5∏/12	6∏/12
Y	.00000	.25882	.50000	.70711	.86603	.96593	1.00000

6. Use the trapezoidal rule to evaluate $\frac{x}{x}$ dividing the interval into 5 equal parts

7. Using a Simpson's rule, evaluate $^{\Pi} sin3x\ dx$ from the following data:

X	0	∏/4	∏/2	∏/4	∏
sinx	0	.7071	1.000	.7071	0

8. The following table gives the values of f(x) at equal interval of x

X	0	0.5	1.0	1.5	2.0
F(x)	0.399	0.352	0.242	0.129	0.054

Evaluate $x\ dx$ using Simpson's rule.

9. Find an approximate value of $\log_e 5$ by calculating to 4 decimal places by Simpson's rule the integral $\frac{x}{x}$ dividing the range into 10 equal parts.

10. Numerically integrate e^{-x} between $0 \leq x \leq 1$ in steps of 0.1 by each of the following (a) trapezoidal rule

UNIT V

1. Define Runge-kutta method.

2. Using euler's improved method, find the value of y when x=0.1 given that y(0)=1 and $y^1=x^2+y$

3. Using $dy/dx=x^2+y$, y(0)=1, determine y(0.02), y(0.04) and y(0.06) using euler's modified method.

4. Using euler's method and its modified form, obtain y(0.2), y(0.4), y(0.6) correct to three decimal places if y satisfies.

$Dy/dx=y-x^2$, y(0)=1

5. Using modified method of Euler: solve dy/dx=1-y, y(0)=0 in the range $o \leq x \leq 0.3$ taking h=0.1

6. Derive the improved euler's method and the modified euler's method from the Runge-kutta method of second order.

7. Prove that the solution for the equation dy/dx=y, y(0)=1 yields $y_m=[1+h=1/2h^2]^2$, using second order Runge-kutta method.

8. Evaluate the solution at x=0.1, 0.2, 0.3 of the following problem by second order Runge-kutta method.

$Y^1=1/2(1+x)y^2$, y(0)=1

9. Tabulated by Runge-kutta method the numerical solution of

$dy/dx=1+y^2$ with y(0)=0

And the step size h=0.2 for x=0, 0.2, 0.4, 0.6, 0.8, 0.10.

10. Given $d^2y/dx^2-y^3=0$, y(0)=10, $y^1(0)=5$ evaluate y(0.1) using Runge-kutta method.

Numerical Techniques

K4 Level Questions

UNIT I

1. Find the roots of the equation $x^3-4x-9=0$ correct to three decimal places by using bisection method

2. Find the real roots of the equation $\rho-\rho^3/3+\rho^5/10-\rho^7/42+\rho^9/216-\ldots=0.4431135$

3. compute the real roots of xlog10x-1.2=0 correct five decimal places (regular falsi method).

4. Derive Bisection method.

5. Using Newton-Raphson method establish the formula $X_{n+1}=1\backslash 2(x_n+N\backslash X_n)$ to calculate the square root of N. Hence find the square root of 5 correct to 4 decimal places.

UNIT II

1. State and prove Newton's forward interpolation formula.
2. State and prove Newton's backward interpolation formula.
3. The following are data from the steam table

Temperature (℃)	140	150	160	170	180
Pressure (kgf\cm^2)	3.685	4.854	6.302	8.076	10.225

Using Newton's formula find the pressure of the steam for a temperature of 142℃.

4. Estimate exp (1.85) from the following table

x	1.7	1.8	1.9	2.0	2.1	2.2	2.3
Exp(x)	5.474	6.050	6.686	7.389	8.166	9.025	9.974

5. Given $\mu_0=-4$, $\mu_1=-2$, $\mu_4=220$, $\mu_5=546$, $\mu_6=1148$ find μ_2 and μ_3.

UNIT III

1. State and prove Newton's forward difference formula.
2. State and prove Newton's backward difference formula.
3. From the following table of values of x and y, find dy/dx and d^2y/dx^2 for x=1.05

x	1.00	1.05	1.10	1.15	1.20	1.25	1.30
y	1.00000	1.02470	1.04881	1.07238	1.09544	1.11803	1.14017

4. The following table gives the results of an observation. θ is the observed temperature in degrees centigrade of a vessel of cooling water; t is the time in minutes from the beginning of observation:

T	1	3	5	7	9
θ	85.3	74.5	67.0	60.5	54.3

Find approximately the rate of cooling when t=8 using Newton's backward formula.

5. From the following table, find the value of x for which y is minimum and find this value of y

X	.60	.65	.70	.75
Y	.6221	.6155	.6188	.6170

UNIT IV

1. Dividing the range into 10 equal parts, find the approximate value of $\int^{\Pi} sinx\ dx$ by (a) Trapezoidal rule, (b) Simpson's rule

2. Use Romberg's method to compute $\int \frac{}{} dx$ correct to 4 decimal places. Hence deduce an approximate value of $\prod$.

3. Define Simpson's rule.

4. Evaluate $\int \frac{}{} dx$ correct to three decimal places by trapezoidal rule with h=.5, .25, .125. Use Romberg's integration to get an accurate value for the definite integral. Hence find the value of $\log_e 2$.

5. Apply Simpson's rule to evaluate $\int \frac{}{}$ two decimal places, by dividing the range into 4 equal parts.

UNIT V

1. Derive improved Euler's method.

2. Derive second order Runge-kutta method.

3. Solve the equation dy/dx=1-y with the initial condition x=0, y=0, using euler's algorithm and tabulated the solutions by euler's improved method and euler's modified method. Also compare with the exact solution.

4. Apply the fourth order Runge-kutta method, to find an approximate value of y when x=0.2, given that y^1=x+y, y(0)=1.

5. Solve the system of differential equations dy/dx=xz+1, dy/dx=-xy for x=0.3(0.3)0.9