

## Mth603 Just Final term MCQS

(latest quiz included and FAQs and Glossary is also included in this file)

Plz must learn the FAQs and Glossary for Mcqs and short question..

It is very helpful By MC110402046

Tayyaba Rehmna MCS 4<sup>th</sup> semester

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If we wanted to find the value of a definite integral with an infinite limit, we can instead replace the infinite limit with a variable, and then take the limit as this variable goes to

\_\_\_\_\_.

Constant

Finite

**Infinity**

zero

In Runge – Kutta Method, we do not need to calculate higher order derivatives and find greater accuracy.

**True**

False

In Simpson's 3/8 rule, the global error is of

$O(h^2)$

$O(h^3)$

$O(h^4)$

None of given

The characteristics polynomial of a  $3 \times 3$  identity matrix is \_\_\_\_\_, if  $x$  is the eigen values of the given  $3 \times 3$  identity matrix. where symbol  $\wedge$  shows power.

$(x-1)^3$

**$(x+1)^3$**  i m not sure about this answer

$x^3-1$

$x^3+1$

In Richardson's extrapolation method, we usually use two different step sizes .....and ..... to yield a higher order method.

**$h, h/2$**

$h, h/3$

$h, h/4$

None

In Simpson's 3/8 rule, we divide the interval of integration into  $n$  sub-intervals. Where  $n$  is divisible by.....

**3**

4

5

None

Euler's method is only useful for a few steps and small step sizes; however Euler's method together with Richardson extrapolation may be used to increase the

\_\_\_\_\_.

**order and accuracy**

divergence

The first Ingrange polynomial with equally spaced nodes produced the formula for

\_\_\_\_\_.

Simpson's rule

**Trapezoidal rule**

Newton's method

Richardson's method

The need of numerical integration arises for evaluating the indefinite integral of a function that has no explicit antiderivative or whose antiderivative is not easy to obtain.

TRUE

**FALSE**

The Trapezoidal Rule is an improvement over using rectangles because we have much less "missing" from our calculations. We used \_\_\_\_\_ to model the curve in trapezoidal Rule

**straight lines**

curves

parabolas

constant

The Euler method is numerically unstable because of \_\_\_\_\_ convergence of error.

Slow

Fast

Moderate

No

Adams – Bashforth is a multistep method.

**True**

False

1. The relationship between central difference operator and the shift operator is given by

▶  $\delta = E - E^{-1}$

▶  $\delta = E + E^{-1}$

▶  $\delta = E^{\frac{1}{2}} + E^{-\frac{1}{2}}$

▶  $\delta = E^{\frac{1}{2}} - E^{-\frac{1}{2}}$

2. In Simpson's 3/8 rule,  $f(x)$  is of the form

▶  $ax + b$

▶  $ax^2 + bx + c$

▶  $ax^3 + bx^2 + cx + d$

▶  $ax^4 + bx^3 + cx^2 + dx + e$

3. In Trapezoidal rule, the integral is computed on each of the sub-intervals by using linear interpolating formula, ie. For n=1 and then summing them up to obtain the desired integral.

- True
- False

4. If  $f(x)$  contains trigonometric, exponential or logarithmic functions then this equation is known as

- Transcendental equation
- Algebraic
- Polynomial
- Linear

The step size "h" in numerical integration over the interval [a,b] is defined as

h=(b-a)/n

**ok(page 227)**

The single definite integral of a function is called

Area under the curve

**ok(page 176)**

Integration is a .....process.

Summing

**ok(page 170)**

While employing Trapezoidal and Simpson Rules to evaluate the double integral numerically, by using Trapezoidal and Simpson rule with respect to ----- variable/variables at time

single

**(page 185)**

To evaluate numerically a double integral over a rectangular region bounded by the lines  $x = a$ ,  $x = b$ ,  $y = c$ ,  $y = d$  we shall employ either trapezoidal rule or Simpson's rule, repeatedly with respect to .....variable at a time.

One

**ok(page 185)**

To evaluate a definite integral of tabular function  $f(x)$ , piecewise quadratic approximation led to -----

Simpson's Rule

**(page 252)**

In Simpson's rule, we can estimate the integral by .....the areas under the parabolic arcs through three successive points.

Adding

**ok**  
<http://pages.pacificcoast.net/~cazelais/187/simps on.pdf>

In Newton-Cotes formula for finding the definite integral of a tabular function, which of the following is taken as an approximate function then find the desired integral?

- Trigonometric Function
- Exponential Function
- Logarithmic Function
- Polynomial Function**

If the area under  $f(x) = x'$  in interval  $[0,2]$  is subdivided into two equal sub-intervals of width '1' with left end points, then which of the following will be the Truncation Error provided that  $I(\text{definite integral}) = 2$  and approximate sum = 3 ?

- 0
- 1
- 1
- 3

Trapezoidal and Simpson's integrations are just a linear combination of values of the given function at different values of the .....variable.

- Dependent
- Independent**
- Arbitrary
- None of the given choices

The percentage error in numerical integration is defined as

- $=(\text{Theoretical Value}-\text{Experiment Value}) * \text{Experiment Value} * 100$**
- $=(\text{Theoretical Value} + \text{Experiment Value}) / \text{Experiment Value} * 100$
- $=(\text{Theoretical Value}-\text{Experiment Value}) / \text{Theoretical Value} * 100$
- $=(\text{Theoretical Value}-\text{Experiment Value}) / \text{Experiment Value} * 100$

Simpson's 3/8 rule is based on fitting ..... points by a cubic.

- Two
- Three
- Four**
- None of the given choices

We can improve the accuracy of trapezoidal and Simpson's rules using .....

- Simpson's 1/3 rule
- Simpson's 3/8 rule
- Richardson's extrapolation method**
- None of the given choices

In the process of Numerical Differentiation, we differentiate an interpolating polynomial in place of -----.

- actual function
- extrapolating polynomial
- Lagrange's polynomial
- Newton's Divided Difference Interpolating polynomial**

In Simpson's 1/3 rule, the global error is of .....

- $O(h^2)$
- $O(h^3)$
- $O(h^4)$**
- None of the given choices

Which of the following is the Global Error for Simpson's 3/8 Rule while integrating ' $f(x) = \text{Cos}x$ ' in the interval of  $[0,\pi]$  of equally spaced subinterval of width ' $h = \pi/6$ ' and intermediate point  $x = \pi/2$ ?

We shall at first divide the range of integration  $(0, \pi/2)$  part is of width  $\pi/6$  and write down the table of values

X	0	$\pi/6$	$\pi/3$	$\pi/2$
Y=sinx	0.0	0.5	0.8660	1.0

Which of the following is the Cote's number (weighting coefficient) for the function:  $f(x) = x+1$  in the interval  $[0,1]$ ?

**ok**( $h=b-a/n$ )

## Midterm Objective MTH603

Solved 100% correct

Tayyaba Rehman MC110402046

MCS 4<sup>th</sup> semester.

**Exact solution of 2/3 is not exists.**

**TRUE**

FALSE

**A 3 x 3 identity matrix have three and \_\_\_\_\_ eigen values.**

**Same**

Different

**Eigenvalues of a symmetric matrix are all \_\_\_\_\_ .**

**Real**

Complex

Zero

Positive

**The Jacobi iteration converges, if A is strictly diagonally dominant.**

**TRUE**

FALSE

**Below are all the finite difference methods EXCEPT \_\_\_\_\_.**

Jacobi's method

Newton's backward difference method

**Stirling formula**

Forward difference method

**If n x n matrices A and B are similar, then they have the same eigenvalues (with the same multiplicities).**

TRUE

**FALSE**

**If A is a nxn triangular matrix (upper triangular, lower triangular) or diagonal matrix, the eigenvalues of A are the diagonal entries of A.**

**TRUE**

FALSE

**The characteristics polynomial of a 3x 3**

**Identity matrix is \_\_\_\_\_, if x is the Eigen values of the given 3 x 3 identity matrix. Where symbol ^ shows power.**

$(X-1)^3$

$(x+1)^3$

$X^3-1$

**$X^3+1$**

**Two matrices with the same characteristic polynomial need not be similar.**

**TRUE**

FALSE

The Jacobi's method is a method of solving a matrix equation on a matrix that has \_\_\_\_ zeros along its main diagonal.

**no**

atleast one

**Bisection method is a**

**Bracketing method**

Open method

**Regula Falsi means**

Method of Correct position

Method of unknown position

**Method of false position**

Method of known position

**An eigenvector V is said to be normalized if the coordinate of largest magnitude is equal to zero.**

Select correct option:

TRUE

**FALSE** (unity ay ga zero ki jaga)

The Gauss-Seidel method is applicable to strictly diagonally dominant or symmetric \_\_\_\_\_ definite matrices A.

Select correct option:

**Positive**

Negative

Differences methods find the \_\_\_\_\_ solution of the system.

Select correct option:

**Numerical**

Analytical

The Power method can be used only to find the eigenvalue of A that is largest in absolute **value**—we call this Eigenvalue the dominant eigenvalue of A.

Select correct option:

**TRUE**

FALSE

The Jacobi's method is a method of solving a matrix equation on a matrix that has no zeros along its \_\_\_\_\_.

Select correct option:

**Main diagonal**

Last column

Last row

First row

A 3 x 3 identity matrix have three and different Eigen values.

Select correct option:

**TRUE**

FALSE

**Newton Raphson method falls in the category of**

Bracketing method

**Open Method**

Iterative Method

Indirect Method

**Newton Raphson method is also known as**

**Tangent Method**

Root method

Open Method

Iterative Method

**Secant Method uses values for approximation**

1

3

**2**

4

**Secant Method is than bisection method for finding root**

Slow

**Faster**

**In Newton Raphson method**

Root is bracketed

**Root is not bracketed**

**Regula falsi method and bisection method are both**

**Convergent**

Divergent

**In bisection method the two points between which the root lies are**

Similar to each other

Different

Not defined

**Opposite**

**In which methods we do not need initial approximation to start**

Indirect Method

Open Method

**Direct Method**

Iterative Method

**Root may be**

Complex

Real

**Complex or real**

None

**In Regula falsi method we choose points that have signs**

**2 points opposite signs**

3 points opposite signs

2 points similar signs

None of the given

**In a bounded function values lie between**

**1 and -1**

1 and 2

0 and 1

0 and -2

**Newton Raphson method is a method which when it leads to division of number close to zero**

**Diverges**

Converges

Which of the following method **vsolutions** is modified form of Newton Raphson Method?

Regula falsi method

Bisection method

**Secant method**

Jacobi's Method

Which 1 of the following is generalization of Secant method?

**Muller's Method**

Jacobi's Method

Bisection Method

N-R Method

Secant Method needs starting points

2

**3**

4

1

Near a simple root Muller's Method converges than the secant method

**Faster**

Slower

If **S** is an identity matrix, then

$$S^{-1} = S$$

$$S^t = S$$

$$S^{-1} = S^t$$

**All are true**

If we retain **r+1** terms in Newton's forward difference formula, we

obtain a polynomial of degree ---- agreeing with  $y_x$  at  $x_0, x_1, \dots, x_r$

r+2

r+1

**R**

R-1

**P in Newton's forward difference formula is defined as**

$$p = \left(\frac{x - x_0}{h}\right)$$

$$p = \left(\frac{x + x_0}{h}\right)$$

$$p = \left(\frac{x + x_n}{h}\right)$$

$$p = \left(\frac{x - x_n}{h}\right)$$

**Octal numbers has the base**

10

2

**8**

16

**Newton's divided difference interpolation formula is used when the values of the independent variable are**

**Equally spaced**

Not equally spaced

Constant

None of the above

**Given the following data**

x	0	1	2	4
---	---	---	---	---

$f(x)$	1	1	2	5
--------	---	---	---	---

Value of  $f(2,4)$  is

1.5

**3**

2

1

If  $y(x)$  is approximated by a polynomial  $P_n(x)$  of degree n then the error is given by

$$\varepsilon(x) = y(x) + P_n(x)$$

$$\varepsilon(x) = y(x) - P_n(x)$$

$$\varepsilon(x) = y(x) \times P_n(x)$$

$$\varepsilon(x) = P_n(x) + y(x)$$

Let  $I$  denotes the closed interval spanned by  $x_0, x_1, x_2, x_3, x_4, x_5, x_6, x_7, \bar{x}$ . Then  $F(x)$  vanishes -----times in the interval  $I$ .

N-1

**N+2**

N

N+1

Differential operator in terms of forward difference operator is given by

$$D = \frac{1}{h} \left( \Delta + \frac{\Delta^2}{2!} + \frac{\Delta^3}{3!} + \frac{\Delta^4}{4!} + \frac{\Delta^5}{5!} + \dots \right)$$

$$D = \frac{1}{h} \left( \Delta + \frac{\Delta^2}{2} + \frac{\Delta^3}{3} + \frac{\Delta^4}{4} + \frac{\Delta^5}{5} + \dots \right)$$

$$D = \frac{1}{h} \left( \Delta - \frac{\Delta^2}{2} + \frac{\Delta^3}{3} - \frac{\Delta^4}{4} + \frac{\Delta^5}{5} - \dots \right)$$

$$D = \frac{1}{h} \left( \Delta - \frac{\Delta^2}{2!} + \frac{\Delta^3}{3!} - \frac{\Delta^4}{4!} + \frac{\Delta^5}{5!} - \dots \right)$$

Finding the first

derivative of  $f(x)$  at  $x=0.4$  from the following table:

$x$	0.1	0.2	0.3	0.4
$f(x)$	1.10517	1.22140	1.34986	1.49182

**Differential operator in terms of -----will be used.**

Forward difference operator

**Backward difference operator**

Central difference operator

All of the given choices

For the given table of values

$x$	0.1	0.2	0.3	0.4	0.5	0.6
$f(x)$	0.425	0.475	0.400	0.452	0.525	0.575

$f'(0.1)$ , using two-point equation will be calculated as.....

-0.5

**0.5**

0.75

-0.75

In Simpson's 1/3 rule,  $f(x)$  is of the form

**$ax+b$**

▶  $ax^2+bx+c$

▶  $ax^3+bx^2+cx+d$

▶  $ax^4+bx^3+cx^2+dx+e$

$$I = \int_a^b f(x)dx$$

While integrating  $\int_a^b f(x)dx$ ,  $h$ , width of the interval, is found by the formula-----

$$\frac{b-a}{n}$$

$$\frac{b+a}{n}$$

$$\frac{a-b}{n}$$

None of the given choices

To apply Simpson's 1/3 rule, valid number of intervals are.....

7

**8 (bc it is even)**

5

3

For the given

table of values

$x$	0.1	0.2	0.3	0.4	0.5	0.6
$f(x)$	0.425	0.475	0.400	0.452	0.525	0.575

$f''(0.2)$ , using three-point equation will be calculated as .....

17.5

12.5

7.5

**-12.5**

\_\_\_\_\_ To apply  
Simpson's 1/3 rule, the **number of intervals** in the following must be

**2** (Simpson's 1/3 rule must use an even number of elements')

3

5

7

\_\_\_\_\_ To apply  
Simpson's 3/8 rule, the number of intervals in the following must be

10

11

**12** (bc it is divisible by 3)

13

If the root of the given equation lies between a and b, then the first approximation to the root of the equation by bisection method is .....

$$\frac{(a+b)}{2}$$

$$\frac{(a-b)}{2}$$

$$\frac{(b-a)}{2}$$

None of the given choices

.....lies in the category of iterative method.

Bisection Method

Regula Falsi Method

Secant Method

**All of the given choices**

For the equation  $x^3 + 3x - 1 = 0$ , the root of the equation lies in the interval.....

(1, 3)

(1, 2)

**(0, 1)**

(1, 2)

**Rate of change of any quantity with respect to another can be modeled by**

**An ordinary differential equation**

A partial differential equation

A polynomial equation

None of the given choices

If

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

**Then the integral of this equation is a curve in**

None of the given choices

Xt-plane

Yt-plane

**Xy-plane**

**In solving the differential equation**

$$y' = x + y ; y(0.1) = 1.1$$

$h = 0.1$ , **By Euler's method**  $y^{(0.2)}$  **is calculated as**

1.44

1.11

**1.22**

1.33

In second order Runge-Kutta method

$k_1$  is given by

$$k_1 = hf(x_n, y_n)$$

$$k_1 = 2hf(x_n, y_n)$$

$$k_1 = 3hf(x_n, y_n)$$

None of the given choices

In fourth order Runge-Kutta method,  $k_2$  is given by

$$k_2 = hf\left(x_n + \frac{h}{2}, y_n + \frac{k_1}{2}\right)$$

$$k_2 = hf\left(x_n + \frac{h}{3}, y_n + \frac{k_1}{3}\right)$$

$$k_2 = hf\left(x_n - \frac{h}{3}, y_n - \frac{k_1}{3}\right)$$

$$k_2 = hf\left(x_n - \frac{h}{2}, y_n - \frac{k_1}{2}\right)$$

In fourth order Runge-Kutta method,  $k_4$  is given by

$$k_3 = hf(x_n + 2h, y_n + 2k_3)$$

$$k_3 = hf(x_n - h, y_n - k_3)$$

$$k_3 = hf(x_n + h, y_n + k_3)$$

None of the given choices

**Adam-Moulton P-C method is derived by employing**

**Newton's backward difference interpolation formula**

Newton's forward difference interpolation formula

Newton's divided difference interpolation formula

None of the given choices

**The need of numerical integration arises for evaluating the definite integral of a function that has no explicit \_\_\_\_\_ or whose antiderivative is not easy to obtain**

Derivatives

**Antiderivative**

**If  $|A| \neq 0$  then system will have a**

Definite solution

**Unique solution**

Correct solution

No solution

**If  $|A| = 0$  then**

There is a unique solution

There exists a complete solution

**There exists no solution**

None of the above options

**Direct method consists of method**

**2 (elimination and decomposition)**

3

5

4

**We consider Jacobi's method Gauss Seidel Method and relaxation method as**

Direct method

**Iterative method**

Open method

All of the above

**In Gauss Elimination method Solution of equation is obtained in**

3 stages

**2 stages**

4 stages

5 stages

**Gauss Elimination method fails if any one of the pivot values becomes**

Greater

Small

**Zero**

None of the given

**Changing the order of the equation is known as**

**Pivoting**

Interpretation

**Full pivoting is than partial pivoting**

Easy

**More complicated**

**The following is the variation of Gauss Elimination method**

Jacobi's method

**Gauss Jordan Elimination method**

**Courts reduction method is also known as Cholesky Reduction method**

**True**

False

**Jacobi's method is also known as method of Simultaneous displacement**

**True**

False

Bisection and false position methods are also known as bracketing method and are always

Divergent =>Convergent

The Inverse of a matrix can only be found if the matrix is

Singular Scalar Diagonal =>Non-singular

If  $f(x)$  contains trigonometric, exponential or logarithmic functions then this equation is known as

=>Transcendental Equation Algebraic Polynomial Linear

In interpolation is used to represent the  $\delta$  Forward difference ?

=>Central difference Backward difference

The base of the decimal system is ----

=>10 0 2 8 None of the above.

The determinant of a diagonal matrix is the product of the diagonal elements. =>True False

Power method is applicable if the eigen vectors corresponding to eigen values are linearly independent.

=>True false

If  $n \times n$  matrices A and B are similar, then they have the different eigenvalues (with the same multiplicities).

True =>False

An eigenvector V is said to be normalized if the coordinate of largest magnitude is equal to ----.

=>Unity zero

The determinant of a ---- matrix is the product of the diagonal elements.

=>Diagonal Upper triangular Lower triangular Scalar

The Power method can be used only to find the eigen value of A that is largest in absolute value—we call this eigen value the dominant eigen value of A. =>True False

For differences methods we require the set of values. =>True False

If  $x$  is an eigen value corresponding to eigen value of  $V$  of a matrix  $A$ . If  $a$  is any constant, then  $x - a$  is an eigen value corresponding to eigen vector  $V$  is an of the matrix  $A - a I$ . =>True False

Central difference method seems to be giving a better approximation, however it requires more computations.

True =>False

Iterative algorithms can be more rapid than direct methods. =>True False

Central Difference method is the finite difference method. =>True False

If  $A$  is a  $n \times n$  triangular matrix (upper triangular, lower triangular) or diagonal matrix, the eigenvalues of  $A$  are the diagonal entries of  $A$ . => TRUE FALSE

Q: While solving by Gauss-Seidel method, which of the following is the first iterative solution for the system;  $x-2y=1$ ,  $x+4y=4$  ?

=>(1, 0.75) (0,0) (1,0) (0,1)

Sparse matrices arise in computing the numerical solution of .....

Ordinary differential equations =>Partial differential equations

Linear differential equations Non-linear differential equations

Q: While solving a system of linear equations by Gauss Jordan Method, after all the elementary row operations if there lefts also zeros on the main diagonal then which of the is true about the system?

System may have unique solutions

**System has no solution**

System may have multiple numbers of finite solutions

System may have infinite many solutions

(because • **Gauss-Jordan Reduction of a matrix for a system can reveal if the system has :**

- **Unique Solution** : Look for all non-zero values down the main diagonal.
- **Infinite Solution** : Bottom row(s) are all zeroes.
- **No Solution** : A bottom row implies a contradiction, i.e. <zeroes> = <nonzero>

)

Q: Which of the following method is not an iterative method?

Jacobi's method    Gauss-Seidel method    Relaxation methods    =>Gauss-Jordan elimination method

Q: Numerical methods for finding the solution of the system of equations are classified as direct and ..... methods:.....; Indirect    =>Iterative    Jacobi    None of the given choices

Q: If the Relaxation method is applied on the system;  $2x+3y = 1$ ,  $3x +2y = - 4$ , then largest residual in 1st iteration will reduce to -----.

Zero    =>4    -1    -1

In ..... method, the elements above and below the diagonal are simultaneously made zero.

Select correct option:

Jacobi's    Gauss-Seidel    =>Gauss-Jordan Elimination    Relaxation

If the order of coefficient matrix corresponding to system of linear equations is  $3 \times 3$  then which of the following will be the orders of its decomposed matrices; 'L' and 'U'?

Select correct option:

=>Order of 'L' =  $3 \times 1$ , Order of 'U' =  $1 \times 3$     Order of 'L' =  $3 \times 2$ , Order of 'U' =  $2 \times 3$

Order of 'L' =  $3 \times 3$ , Order of 'U' =  $3 \times 3$     Order of 'L' =  $3 \times 4$ , Order of 'U' =  $4 \times 3$

Which of the following is equivalent form of the system of equations in matrix form;  $AX=B$  ?

Select correct option:

$XA = B$     =>  $X = B(\text{Inverse of } A)$      $X = (\text{Inverse of } A)B$      $BX = A$

Which of the following rearrangement make strictly diagonal dominant, the system of linear equations;  $x-3y+z = -2$ ,  $-6x+4y+11z=1$ ,  $5x-2y-2z=9$ ?

$5x-2y-2z=9$ ,  $x-3y+z = -2$ ,  $-6x+4y+11z=1$     => $-6x+4y+11z=1$ ,  $x-3y+z = -2$ ,  $5x-2y-2z=9$

=> $5x-2y-2z=9$ ,  $-6x+4y+11z=1$ ,  $x-3y+z = -2$

No need to rearrange as system is already in diagonal dominant form.

If the determinant of a matrix A is not equal to zero then the system of equations will have.....

=>a unique solution   many solutions   infinite many solutions   None of the given choices

Sparse matrix is a matrix with .....

Some elements are zero   =>Many elements are zero

Some elements are one   Many elements are one

Which of the following is the meaning of partial pivoting while employing the row transformations?

Select correct option:

=>Making the largest element as pivot   Making the smallest element as pivot

Making any element as pivot   Making zero elements as pivot

While solving the system;  $x-2y = 1$ ,  $x+4y = 4$  by Gauss-Seidel method, which of the following ordering is feasible to have good approximate solution?:

$x+4y = 1$ ,  $x-2y = 4$     $x+2y = 1$ ,  $x-4y = 4$     $x+4y = 4$ ,  $x-2y = 1$    =>no need to reordering

Back substitution procedure is used in .....

=>Gaussian Elimination Method   Jacobi's method

Gauss-Seidel method   None of the given choices

The linear equation:  $2x+0y-2=0$  has ----- solution/solutions.

=>unique   no solution   infinite many   finite many

If a system of equations has a property that each of the equation possesses one large coefficient and the larger coefficients in the equations correspond to different unknowns in different equations, then which of the following iterative method id preferred to apply?

Gauss-Seidel method   Gauss-Jordon method   =>Gauss elimination method   Crout's method

When the condition of diagonal dominance becomes true in Jacobi's Method.Then its means that the method is

Select correct option:

Stable   Unstable   =>Convergent   Divergent

For a system of linear equations, the corresponding coefficient matrix has the value of determinant;  $|A| = 0$ , then which of the following is true?

The system has unique solution   The system has finite multiple solutions

The system has infinite many solutions      =>The system has no solution

For the system;  $2x+3y = 1$ ,  $3x + 2y = - 4$ , if the iterative solution is  $(0,0)$  and 'dxi = 2' is the increment in 'y' then which of the following will be taken as next iterative solution?

**(2.0)**      (0.3)      (0.2)      (1.-4)

If system of equations is inconsistent then its means that it has .....

**=>No Solutions**      Many solutions      Infinite Many solutions      None of the given choices

While using Relaxation method, which of the following is the Residuals for 1st iteration on the system;  $2x+3y = 1$ ,  $3x + 2y = 4$

(2,3)      (3,-2)      (-2,3)      **=>(1,4)**

Relaxation Method is a/an .....      Direct method      **=>Iterative method**

Gauss - Jordan Method is similar to .....

Gauss–Seidel method      Iteration's method      Relaxation Method      **=>Gaussian elimination method**

Full pivoting, in fact, is more .....than the partial pivoting.

Easiest      **=>Complicated**

Gauss–Seidel method is also known as method of .....

**Successive displacement** =>Iterations      False position      None of the given choices

The Jacobi iteration ---, if A is strictly diagonally dominant.

**=>converges**      diverges

Power method is applicable if the eigen vectors corresponding to eigen values are linearly ----.:

**=>independent**      dependent

Power method is applicable if the eigen values are -----.

**=>real and distinct**      real and equal      positive and distinct      negative and distinct

How many Eigen vectors will exist corresponding to the function;  $\text{Exp}(ax) = e^{ax}$ , when the matrix operator is of

differentiation?

=>Infinite many Unique Finite Multiple None

By using determinants, we can easily check that the solution of the given system of linear equation --- and it is --

=>exists, unique exists, consistent trivial, unique nontrivial, inconsistent

Eigenvectors of a symmetric matrix are orthogonal, but only for distinct eigenvalues.

=>TRUE FALSE

Two matrices with the ---- characteristic polynomial need not be similar.

=>same different

The absolute value of a determinant ( $|\det A|$ ) is the product of the absolute values of the eigenvalues of matrix A

=>TRUE FALSE

The eigenvectors of a square matrix are the non-zero vectors that, after being multiplied by the matrix, remain ..... to the original vector.

Perpendicular Parallel =>Diagonal None of the given choices

In Jacobi's method after finding D1, the sum of the diagonal elements of D1 should be ..... to the sum of the diagonal elements of the original matrix A.

Greater than Less than =>Same Different

---

Gauss Seidel method is also **vusolutions** known as method of Successive displacement

False

True

In Jacobi's method approximation calculated is used for

Nothing

**Calculating the next approximation**

Replaced by previous one

All above

**In Gauss Seidel method approximation calculated is replaced by previous one**

**True**

False

Relaxation method is derived by

**South well**

Not defined

**Power method is applicable for only**

Real metrics

Symmetric

Unsymmetrical

**Both symmetric and real**

**The process of eliminating value of y for intermediate value of x is know as interpolation**

**True**

False

**Computer uses the words that are**

Infinite

**Finite**

**If the root lies between a and b then we will use bisection formula as**

$$\frac{(a+b)}{2}$$

$$\frac{(a-b)}{2}$$

$$\frac{(b-a)}{2}$$

None of the given choices

**Differences methods are iterative methods.**

**TRUE**

FALSE

**Eigen values of a \_\_\_\_\_ matrix are all real.**

**symmetric**

antisymmetric

rectangular

triangular

**Question :** While solving a system of linear equations, which of the following approach is economical for the computer memory?

Select correct option:

Direct

Iterative

Analytical

**Graphical**

**Question :** The basic idea of relaxation method is to reduce the largest residual to .....

One

Two

**Zero**

None of the given choices

**Question :** Which of the following is a reason due to which the LU decomposition of the system of linear equations;  $x+y=1$ ,  $x+y=2$  is not possible?

Associated coefficient matrix is singular

All values of l's and u's can't be evaluated

Determinant of coefficient matrix is zero

**All are equivalent**

**Question :** While using Relaxation method, which of the following is the largest Residual for 1st iteration on the system;  $2x+3y=1$ ,  $3x+2y=-4$  ?

-4

**3**

2

1

**Question :** Jacobi's Method is a/an.....

### Iterative method

Direct metho

**Question:** In ..... method, a system is reduced to an equivalent diagonal form using elementary transformations.

Jacobi's

Gauss-Seidel

Relaxation

### Gaussian elimination

**Question :** Under elimination methods, we consider, Gaussian elimination and .....methods. :

Gauss-Seidel

Jacobi

### Gauss-Jordan elimination

None of the given choices

**Question :** Gauss-Seidel method is similar to .....

Iteration's method

Regula-Falsi method

Jacobi's method

### None of the given choices

**Question :** If the root of the given equation lies between a and b, then the first approximation to the root of the equation by bisection method is .....

$\frac{(a+b)}{2}$

$\frac{(a-b)}{2}$

$\frac{(b-a)}{2}$

None of the given choices

.The Gauss-Seidel method is applicable to strictly diagonally dominant or symmetric positive definite matrices A.

### True

False

**Question :** Simpson's rule is a numerical method that approximates the value of a definite integral by using polynomials.

### Quadratic

Linear

Cubic

Quartic

**Question :** .In Simpson's Rule, we use parabolas to approximating each part of the curve. This proves to be very efficient as compared to Trapezoidal rule.

### True

False

**Question :** The predictor-corrector method an implicit method. (multi-step methods)

True

### False

**Question :** Generally, Adams methods are superior if output at many points is needed.

**True**

False

**Question :** The Trapezoidal rule is a numerical method that approximates the value of a \_\_\_\_\_.

Indefinite integral

**Definite integral**

Improper integral

Function

**Question :** An indefinite integral may \_\_\_\_\_ in the sense that the limit defining it may not exist.

**diverge**

Converge

**Question :** An improper integral is the limit of a definite integral as an endpoint of the interval of integration approaches either a specified real number or  $\infty$  or  $-\infty$  or, in some cases, as both endpoints approach limits.

**TRUE**

FALSE

**Question :** Euler's Method numerically computes the approximate derivative of a function.

**TRUE**

FALSE

**Question :** Euler's Method numerically computes the approximate \_\_\_\_\_ of a function.

Antiderivative

**Derivative**

Error

Value

If we wanted to find the value of a definite integral with an infinite limit, we can instead replace the infinite limit with a variable, and then take the limit as this variable goes to \_\_\_\_\_.

Constant

Finite

**Infinity**

Zero

**Question:** By using determinants, we can easily check that the solution of the given system of linear equation exists and it is unique.

**TRUE**

FALSE

**Question :** Let A be an  $n \times n$  matrix. The number  $x$  is an eigenvalue of A if there exists a non-zero vector  $v$  such that \_\_\_\_\_.

$Av = xv$

**$Ax = xv$  not shore**

$Av + xv = 0$

$Av = Ax1$

**Question :** In Jacobi's Method, the rate of convergence is quite \_\_\_\_\_ compared with other methods.

**slow**

Fast

**Question :** Numerical solution of  $2/3$  up to four decimal places is \_\_\_\_\_.

0.667

0.6666

**0.6667**

0.666671 .

**Question :** Symbol used for forward differences is

**$\Delta$  Correct**

$\delta$

$\mu$

**Question :** The relationship between central difference operator and the shift operator is given by

$$\delta = E - E^{-1}$$

$$\delta = E + E^{-1}$$

$$\delta = E^{1/2} + E^{-1/2}$$

$$\delta = E^{1/2} - E^{-1/2}$$

**Question :** Muller's method requires \_\_\_\_\_ starting points

1

2

**3**

**While using Relaxation method, which of the following is increment 'dxi' corresponding to the largest Residual for 1st iteration on the system;  $2x+3y = 1$ ,  $3x + 2y = - 4$  ?**

Select correct option:

-2

2

3

**4**

**How many Eigen values will exist corresponding to the function;  $\text{Exp}(ax) = e^{ax}$ , when the matrix operator is of differentiation?**

Select correct option:

Finite Multiple

Infinite many

**Unique**

None

If  $S$  is an identity matrix, then

$$S^{-1} = S$$

$$S^t = S$$

$$S^{-1} = S^t$$

**All are true**

Gauss Seidel method is also known as method of Successive displacement

False

**True**

Secant method falls in the category of

Bracketing method

Open method

**Iterative method**

Indirect method

For a system of linear equations, the corresponding coefficient matrix has the value of determinant;  $|A| = -3$ , then which of the following is true?

**The system has unique solution**

The system has finite multiple solutions

The system has infinite many solutions

=>The system has no solution

While solving the system of linear equations;  $x-y=2$ ,  $-x+y=3$  by Jacobi's method, if  $(0,0)$  be its first approximate solution, then which of the following is the second approximate solution?

2.3

2.0

0.3

**Second solution is not exist.**

Q: While solving a system of linear equations by Gauss Jordan Method in which case of the following the partial pivoting is essential?

**When the upper triangular entities is zero**

When the lower triangular entities is zero

When diagonal entities are zero

When pivots are zero

For the system;  $2x+3y = 1$ ,  $3x + 2y = - 4$ , if the iterative solution is  $(0,0)$  and ' $dx_i = 2$ ' is the increment in ' $y$ ' then which of the following will be taken as next iterative solution?

(2.0)    **(0.3)**    (0.2)    (1.-4)

Q: While solving by Gauss-Seidel method, which of the following is the first iterative solution for the system;  $x-2y=1$ ,  $x+4y=4$  ?

=>(1. 0.75) (0.0) **(1.0)** (0.1)

**Question** : Let A be an  $n \times n$  matrix. The number  $x$  is an eigenvalue of A if there exists a non-zero vector  $v$  such that \_\_\_\_\_.

**$Av = xv$**

$Ax = xv$

$Av + xv = 0$

$Av = Ax1$

For the system of equations;  $x=2$ ,  $y=3$ . The inverse of the matrix associated with its coefficients is-----.

singular

**non singular**

non identity

of order  $1 \times 1$

In Gauss-Seidel method, each equation of the system is solved for the unknown with ----- coefficient, in terms of remaining unknowns

smallest

**largest**

any positive

any negative

If there are three equations in two variables, then which of the following is true?

System may have unique solutions

System may have multiple numbers of finite solutions

System may have infinite many solutions

**All above possibilities exist depends on the coefficients of variables**

In ..... method, matrix [A] of the system of equations is decomposed into the product of two matrices [L] and [U], where [L] is a lower-triangular matrix and [U] is an upper-triangular matrix with 1's on its main diagonal

Gauss-Seidel

Gaussian elimination

**Crout's Reduction**

None of the given choices

The linear equation:  $x+y=1$  has ----- solution/solutions.

no solution

**unique**

infinite many

finite many

An augmented matrix may also be used to find the inverse of a matrix by combining it with the ..... matrix.

Inverse

Square

**Identity**

None of the given choices

If the product of two matrices is an identity matrices that is  $AB = I$ , then which of the following is true?

A is transpose of B

**A is inverse of B**

A is singular

B is singular

The Gaussian elimination method fails if any one of the pivot elements becomes.....

Select correct option:

One

**Zero**

In Jacobi's Method, We assume that the .....elements does not vanish.

Select correct option:

**Diagonal**

Off-diagonal

Row

Column

The linear equation:  $0x+0y = 2$  has ----- solution/solutions.

Select correct option:

**unique**

no solution

infinite many

finite many

The system of linear equations;  $2x+3y = 6$ ,  $x+4y = 5$  is not strictly diagonal dominant as-----

Select correct option:

$|2| < |4|$

$|2| < |1|$

$|3| < |4|$

$|2| < |3|$

While solving the system;  $x+4y = 4$ ,  $2x-y = 1$  by Gauss-Seidel method, which of the following ordering will lead more rapidly to the desired order of accuracy?

Select correct option:

no need to reordering

$x-2y = 1$ ,  $x+4y = 4$

$x+4y = 1$ ,  $2x - y = 4$

$2x-y = 1$ ,  $x+4y = 4$

The Gauss-Seidel method is applicable to strictly diagonally dominant or symmetric positive definite matrices A

**TRUE**

FALSE

The dominant eigenvector of a matrix is an eigenvector corresponding to the eigenvalue of largest magnitude (for real numbers, smallest absolute value) of that matrix.

Select correct option:

TRUE

**FALSE**

The gauss-seidel method is applicable to strictly diagonal dominant or symmetric positive definite matrices A.

**True**

False

Cholesky's reduction method is also called..... **Crout's reduction**

Gauss elimination and Gauss-Jordan methods are popular among many methods for finding the .....of a matrix. **inverse**

1) IF matrix after rotation in Jacobi method is  $\begin{bmatrix} 3 & 2 & 0 \\ 2 & 3 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ , then  $\theta$  is found to be

0

$\pi/2$

$$\pi/3$$

$$\pi/4$$

2) If  $4+5i$  is root of quadratic equation  $f(x)=0$  then other root of given equation will be.

**4-5i**

4)if there are two roots of equation and one root is  $2+3i$  then the other root will be.

**2-3i**

Every non-zero vector  $x$  is an eigenvector of the identity matrix with Eigen value .....

Select correct option:

**one**

two

three

four

In Jacobi's Method, the rate of convergence is quite slow compared with other methods.

**TRUE**

FALSE

Jacobi's method is highly recommended for ..... matrix to compute all the Eigen values and the corresponding eigenvectors.

**real symmetric**

non real symmetric

For a function;  $y=f(x)$ , if  $y_0, y_1$  and  $y_2$  are 2,3 and 5 respectively then which of the following will be 2nd order Backward difference at  $y_2 = 5$  ?

-1

-2

**1**

2

For a function;  $y=f(x)$ , if  $y_0, y_1$  and  $y_2$  are 2,3 and 5 respectively then which of the following will be 2nd order Leading difference at  $y_0 = 2$  ?

1

-1

2

-2

In the context of Jacobi's method for finding Eigen values and Eigen vectors of a real symmetric matrix of order  $2 \times 2$ , if  $| -5 |$  be its largest off-diagonal then which of the following will be its corresponding off- diagonal values of Orthogonal Matrix?

$\cos(\theta), -\cos(\theta)$

**$\sin(\theta), \cos(\theta)$**

$\sin(\theta), -\sin(\theta)$

$\sin(\theta), \cos(\theta)$

If  $n \times n$  matrices A and B are similar, then they have the same eigenvalues (with the same multiplicities).

True

False

For differences methods we require the initial approximation

True

false

The Jacobi's method is a method of solving a matrix equation on a matrix that has no zeros along its main diagonal.

Select correct option:

TRUE

FALSE

In the context of Jacobi's method for finding Eigen values and Eigen vectors of a real symmetric matrix of order  $2 \times 2$ , if  $|a_{12}| = 5$  be its largest off-diagonal and its two equal diagonal values are '3' then which of the following will be its corresponding argument value 'theta' of Orthogonal Matrix?

$\pi/3$

$\pi/6$

$\pi/2$

$\pi/4$

The Jacobi's method is a method of solving a matrix equation on a matrix that has no zeros along its main diagonal.

Select correct option:

TRUE

FALSE

For a function;  $y=f(x)$ , if  $y_0, y_1$  and  $y_2$  are 2,3 and 5 respectively then which of the following will be 2nd order Leading difference at  $y_0 = 2$  ?

Select correct option:

1

-1

2

-2

# FAQs

**(these are important for the short questions and MCQS)**

Question: What is Bracketing method?

Answer: Methods such as bisection method and the false position method of finding roots of a nonlinear equation  $f(x) = 0$  require bracketing of the root by two guesses. Such methods are called bracketing methods. These methods are always convergent since they are based on reducing the interval between the two guesses to zero in on the root.

---

Question: What is an Open method?

Answer: In the Newton-Raphson method, the root is not bracketed. Only one initial guess of the root is needed to get the iterative process started to find the root of an equation. Hence, the method falls in the category of open methods.

---

Question: Explain Muller's method briefly.

Answer: In Muller's method,  $f(x) = 0$  is approximated by a second degree polynomial; that is by a quadratic equation that fits through three points in the vicinity of a root. The roots of this quadratic equation are then approximated to the roots of the equation  $f(x) = 0$ . This method is iterative in nature and does not require the evaluation of derivatives as in Newton-Raphson method. This method can also be used to determine both real and complex roots of  $f(x) = 0$ .

---

Question: Explain the difference between the linear and non-linear equations.

Answer: Linear Equation An algebraic equation is said to be linear in which each term is either a constant or the product of a constant and the first power of a single variable. One or more variables can be involved in the linear equations. e.g.  $x+3y+z=0$   $2x-y+4z=7$  etc. Non-Linear Equation An equation is said to Non-Linear equation if it is not linear. Equations involving the power of the variable 2 or higher, transcendental, logarithmic and trigonometric equations etc lie in the category of Non-Linear equations. e.g.  $x^2+5x+3=0$   $\sin x+3y+9=0$   $x \log x-7x+4y=2$  etc.

---

Question: Explain which value is to be chosen as  $X_0$  in N-R method.

Answer: If, for a given function,  $f(a)*f(b)<0$ , then any value between a and b inclusive can be chosen as  $x_0$ .

Question: Define iterative method of solving linear equations with two examples.

Answer: Under iterative methods, the initial approximate solution is assumed to be known and is improved towards the exact solution in an iterative way. We consider Jacobi, Gauss-Seidel and relaxation methods under iterative methods.

---

Question: Define Pivoting.

Answer: The Gaussian elimination method fails if any one of the pivot elements becomes zero. In such a situation, we rewrite the equations in a different order to avoid zero pivots. Changing the order of equations is called pivoting.

---

Question: Write the two steps of solving the linear equations using Gaussian Elimination method.

Answer: In this method, the solution to the system of equations is obtained in two stages. i) the given system of equations is reduced to an equivalent upper triangular form using elementary transformations ii) the upper triangular system is solved using back substitution procedure

---

Question: Describe Gauss-Jordan elimination method briefly

Answer: This method is a variation of Gaussian elimination method. In this method, the elements above

and below the diagonal are simultaneously made zero. That is a given system is reduced to an equivalent diagonal form using elementary transformations. Then the solution of the resulting diagonal system is obtained. Sometimes, we normalize the pivot row with respect to the pivot element, before elimination. Partial pivoting is also used whenever the pivot element becomes zero.

---

Question: Describe briefly Crout's reduction method.

Answer: Here the coefficient matrix  $[A]$  of the system of equations is decomposed into the product of two matrices  $[L]$  and  $[U]$ , where  $[L]$  is a lower-triangular matrix and  $[U]$  is an upper-triangular matrix with 1's on its main diagonal.

Question: Describe briefly the Jacobi's method of solving linear equations.

Answer: This is an iterative method, where initial approximate solution to a given system of equations is assumed and is improved towards the exact solution in an iterative way.

---

Question: What is the difference between Jacobi's method and Gauss Seidel method?

Answer: The difference between Jacobi's method and Gauss Seidel method is that in Jacobi's method the approximation calculated are used in the next iteration for next approximation but in Gauss-Seidel method the new approximation calculated is instantly replaced by the previous one.

---

Question: What is the basic idea of Relaxation method?

Answer: We can improve the solution vector successively by reducing the largest residual to zero at that iteration. This is the basic idea of relaxation method.

---

Question: How the fast convergence in the relaxation method is achieved?

Answer: To achieve the fast convergence of the procedure, we take all terms to one side and then reorder the equations so that the largest negative coefficients in the equations appear on the diagonal.

---

Question: Which matrix will have an inverse?

Answer: Every square non-singular matrix will have an inverse.

Question: What are the popular methods available for finding the inverse of a matrix?

Answer: Gauss elimination and Gauss-Jordan methods are popular among many methods available for finding the inverse of a matrix.

---

Question: Explain Gaussian Elimination Method for finding the inverse of a matrix.

Answer: In this method, if  $A$  is a given matrix, for which we have to find the inverse; at first, we place an identity matrix, whose order is same as that of  $A$ , adjacent to  $A$  which we call an augmented matrix. Then the inverse of  $A$  is computed in two stages. In the first stage,  $A$  is converted into an upper triangular form, using Gaussian elimination method. In the second stage, the above upper triangular matrix is reduced to an identity matrix by row transformations. All these operations are also performed on the adjacently placed identity matrix. Finally, when  $A$  is transformed into an identity matrix, the adjacent matrix gives the inverse of  $A$ . In order to increase the accuracy of the result, it is essential to employ partial pivoting.

---

Question: What are the steps for finding the largest eigen value by power method.

Answer: Procedure Step 1: Choose the initial vector such that the largest element is unity. Step 2: The normalized vector is pre-multiplied by the matrix  $[A]$ . Step 3: The resultant vector is again normalized.

---

Question: What is the method for finding the eigen value of the least magnitude of the matrix  $[A]$ ?

Answer: For finding the eigen value of the least magnitude of the matrix  $[A]$ , we have to apply power method to the inverse of  $[A]$ .

---

Question:	What is interpolation?
Answer:	The process of estimating the value of $y$ , for any intermediate value of $x$ , is called interpolation.
Question:	What is extrapolation?
Answer:	The method of computing the value of $y$ , for a given value of $x$ , lying outside the table of values of $x$ is known as extrapolation.
Question:	What happens when shift operator $E$ operates on the function.
Answer:	When shift operator $E$ operates on the function it results in the next value of the function.
Question:	What is the basic condition for the data to apply Newton's interpolation methods?
Answer:	To apply Newton's interpolation methods, data should be equally spaced.
Question:	When is the Newton's forward difference interpolation formula used?
Answer:	Newton's forward difference interpolation formula is mainly used for interpolating the values of $y$ near the beginning of a set of tabular values and for extrapolating values of $y$ , a short distance backward from $y_0$ .
Question:	When is the Newton's forward difference interpolation formula used?
Answer:	Newton's forward difference interpolation formula is mainly used for interpolating the values of $y$ near the beginning of a set of tabular values and for extrapolating values of $y$ , a short distance backward from $y_0$ .
Question:	When the Newton's backward difference interpolation formula is used?
Answer:	For interpolating the value of the function $y = f(x)$ near the end of table of values, and to extrapolate value of the function a short distance forward from $y_n$ , Newton's backward Interpolation formula is used.
Question:	What is the formula for finding the value of $p$ in Newton's forward difference interpolation formula?
Answer:	$P = (x - x_0)/h$
Question:	What is the formula for finding the value of $p$ in Newton's backward difference interpolation formula?
Answer:	$P = (x - x_n)/h$
Question:	If the values of the independent variable are not equally spaced then which formula should be used for interpolation?
Answer:	If the values of the independent variable are not given at equidistant intervals, then the Lagrange's interpolation formula should be used.
Question:	To use Newton's divided difference interpolation formula, what should the values of independent variables be?
Answer:	To use Newton's divided difference interpolation formula, the values of independent variables should not be equally spaced.
Question:	Which difference formula is symmetric function of its arguments?
Answer:	Divided difference formula is symmetric function of its arguments.
Question:	Is the interpolating polynomial found by Lagrange's and Newton's divided difference formulae is same?
Answer:	Yes. The interpolating polynomial found by Lagrange's and Newton's divided difference formulae is one and the same.

Question: Which formula involves less number of arithmetic operations? Newton or Lagrange's?  
Answer: Newton's formula involves less number of arithmetic operations than that of Lagrange's.

---

Question: When do we need Numerical Methods for differentiation and integration?  
Answer: If the function is known and simple, we can easily obtain its derivative (s) or can evaluate its definite integral. However, if we do not know the function as such or the function is complicated and is given in a tabular form at a set of points  $x_0, x_1, \dots, x_n$ , we use only numerical methods for differentiation or integration of the given function.

---

Question: If the value of the independent variable at which the derivative is to be found appears at the beginning of the table of values, then which formula should be used?  
Answer: If the value of the independent variable at which the derivative is to be found appears at and near the beginning of the table, it is appropriate to use formulae based on forward differences to find the derivatives.

Question: If the value of the independent variable at which the derivative is to be found occurs at the end of the table of values, then which formula should be used?  
Answer: If the value of the independent variable at which the derivative is to be found occurs at the end of the table of values, it is appropriate to use formulae based on backward differences to find the derivatives.

---

Question: Why we need to use RICHARDSON'S EXTRAPOLATION METHOD?  
Answer: To improve the accuracy of the derivative of a function, which is computed by starting with an arbitrarily selected value of  $h$ , Richardson's extrapolation method is often employed in practice.

---

Question: To apply Simpson's 1/3 rule, what should the number of intervals be?  
Answer: To apply Simpson's 1/3 rule, the number of intervals must be even.

---

Question: To apply Simpson's 3/8 rule, what should the number of intervals be?  
Answer: To apply Simpson's 3/8 rule, the number of intervals must be multiple of 3.

---

Question: What is the order of global error in Simpson's 1/3 rule?  
Answer: The global error in Simpson's 1/3 rule is of the order of  $O(h^4)$ .

Question: Is the order of global error in Simpson's 1/3 rule equal to the order of global error in Simpson's 3/8 rule?  
Answer: Yes. The order of global error in Simpson's 1/3 rule equal to the order of global error in Simpson's 3/8 rule.

---

Question: What is the order of global error in Trapezoidal rule?  
Answer: The global error in Trapezoidal rule is of the order of  $O(h^2)$ .

---

Question: What is the formula for finding the width of the interval?  
Answer: Width of the interval,  $h$ , is found by the formula  $h=(b-a)/n$

---

Question: What type of region does the double integration give?  
Answer: Double integration gives the area of the rectangular region.

---

Question: Compare the accuracy of Romberg's integration method to trapezoidal and Simpson's rule.  
Answer: Romberg's integration method is more accurate to trapezoidal and Simpson's rule

Question: What is the order of global error in Simpson's 3/8 rule?  
Answer: The global error in Simpson's 3/8 rule is of the order of  $O(h^4)$ .

---

Question: Which equation models the rate of change of any quantity with respect to another?  
Answer: An ordinary differential equation models the rate of change of any quantity with respect to another.

---

Question: By employing which formula, Adam-Moulton P-C method is derived?  
Answer: Adam-Moulton P-C method is derived by employing Newton's backward difference interpolation formula.

---

Question: What are the commonly used number systems in computers?  
Answer: Binary Octal Decimal Hexadecimal

---

Question: If a system has the base M, then how many different symbols are needed to represent an arbitrary number? Also name those symbols.

Answer:  $M^0, 1, 2, 3, \dots, M-1$

Question: What is inherent error and give its example.

Answer: It is that quantity of error which is present in the statement of the problem itself, before finding its solution. It arises due to the simplified assumptions made in the mathematical modeling of a problem. It can also arise when the data is obtained from certain physical measurements of the parameters of the problem. e.g. if writing 8375 instead of 8379 in a statement lies in the category of inherent error.

---

Question: What is local round-off error?

Answer: At the end of computation of a particular problem, the final results in the computer, which is obviously in binary form, should be converted into decimal form-a form understandable to the user-before their print out. Therefore, an additional error is committed at this stage too. This error is called local round-off error.

---

Question: What is meant by local truncation error?

Answer: Retaining the first few terms of the series up to some fixed terms and truncating the remaining terms arise to local truncation error.

---

Question: What is transcendental equation and give two examples.

Answer: An equation is said to be transcendental equation if it has logarithmic, trigonometric and exponential function or combination of all these three. For example it is a transcendental equation as it has an exponential function These all are the examples of transcendental equation.

---

Question: What is meant by intermediate value property?

Answer: If  $f(x)$  is a real valued continuous function in the closed interval if  $f(a)$  and  $f(b)$  have opposite signs once; that is  $f(x)=0$  has at least one root such that Simply If  $f(x)=0$  is a polynomial equation and if  $f(a)$  and  $f(b)$  are of different signs ,then  $f(x)=0$  must have at least one real root between a and b.

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Question: What is direct methods of solving equations?

Answer: Those methods which do not require any information about the initial approximation of root to start the solution are known as direct methods. The examples of direct methods are Graefee root squaring method, Gauss elimination method and Gauss Jordan method. All these methods do not require any type of initial approximation.

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Question: What is Iterative method of solving equations?

Answer: These methods require an initial approximation to start. Bisection method, Newton raphson

method, secant method, jacobi method are all examples of iterative methods

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Question: If an equation is a transcendental, then in which mode the calculations should be done?

Answer: All the calculations in the transcendental equations should be done in the radian mode.

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Question: What is the convergence criterion in method of iteration?

Answer: If  $\alpha$  be a root of  $f(x) = 0$  which is equivalent to  $I$  be any interval containing the point  $x = \alpha$  and will converge to the root provided that the initial approximation is chosen in  $I$

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Question: When we stop doing iterations when TOL is given?

Answer: Here if TOL is given then we can simply find the value of TOL by subtracting both the consecutive roots and write it in the exponential notation if the required TOL is obtained then we stop.

Question: What is a transcendental equation?

Answer: An equation is said to be a transcendental equation if it has trigonometric, exponential and logarithmic function or combination of all these functions.

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Question: How the value of  $h$  is calculated in interpolation?

Answer: There are two types of data in the interpolation one is equally spaced and other is unequally spaced in equally spaced data we need to calculate the value of  $h$  that is calculated by subtracting any two consecutive values and taking their absolute value.

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Question: What is an algebraic equation?

Answer: An algebraic equation is an equation which is purely polynomial in any variable. Supposed  $x^2+3x+2=0$ ,  $x^4+3x^2=0$ ,  $y^3+6y^2=0$  all are algebraic equations as these are purely polynomial in  $x$  and  $y$  variable.

---

Question: What is Descartes rule of signs?

Answer: The number of positive roots of an algebraic equation  $f(x) = 0$  can not exceed the no of changes in signs. Similarly the no of negative roots of algebraic equation can not exceed the no of changes in sign of equation  $f(-x) = 0$ .

---

Question: What are direct methods?

Answer: The numerical methods which need no information about the initial approximation are known as direct methods like Graeffe's root squaring method.

Question: What is meant by iterative methods?

Answer: The methods which need one or more iterations are known as iterative methods like bisection method, Newton raphson method, and many other methods.

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Question: What is graphically meant by the root of the equation?

Answer: If the graph of a function  $f(x) = 0$  cuts the  $x$ -axis at a point  $a$  then  $a$  is known as the root of the equation.

---

Question: Q. What is the difference between open and bracketing method?

Answer: In open methods we need only one initial approximation of the root that may be anywhere lying and if it is not very close then we have to perform more iteration and the example of open method is Newton raphson method. In bracketing method we bracket the root and find that interval in which root lies means we need two initial approximations for the root finding. Bisection method is an example of the bracketing method.

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Question: Condition for the existence of solution of the system of equations.

Answer: If the  $|A|$  is not equal to zero then the system will have a unique solution if  $|A|=0$  then the

system will have no solution

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Question: Should the system be diagonally dominant for Gauss elimination method?

Answer: The system of equations need not to be diagonally dominant for Gauss elimination method and Gauss Jordan method for both the direct method it is not necessary for the system to be diagonally dominant. It should be diagonally dominant for iterative methods like Jacobi and Gauss-Seidel method.

Question: What is meant by diagonally dominant system?

Answer: A system  $a_1x + b_1y + c_1z = d_1$ ,  $a_2x + b_2y + c_2z = d_2$ ,  $a_3x + b_3y + c_3z = d_3$  is said to be diagonally dominant if the following condition holds.  $|a_1| \Rightarrow (\text{greater or equal}) |b_1| + |c_1|$   $|b_2| \Rightarrow (\text{greater or equal}) |a_2| + |c_2|$   $|c_3| \Rightarrow (\text{greater or equal}) |a_3| + |b_3|$

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Question: State the sufficient condition for the convergence of the system of equations by iterative methods.

Answer: A sufficient condition for convergence of iterative solution to exact solution is  $|a_1| \Rightarrow (\text{greater or equal}) |b_1| + |c_1|$   $|b_2| \Rightarrow (\text{greater or equal}) |a_2| + |c_2|$   $|c_3| \Rightarrow (\text{greater or equal}) |a_3| + |b_3|$  For the system  $a_1x + b_1y + c_1z = d_1$ ,  $a_2x + b_2y + c_2z = d_2$ ,  $a_3x + b_3y + c_3z = d_3$  Similarly for the system with more variables we can also construct the same condition

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Question: The calculation for numerical analysis should be done in degree or radians.

Answer: All the calculation for numerical analysis should be done in radians not in degrees set your calculator in radians mode and suppose the value of  $\pi = 3.14$ .

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Question: How we can identify that Newton forward or backwards interpolation formula is to be used.

Answer: If the value at which we have to interpolate is in the start of the table then we will use Newton's forward interpolation formula if it is at the end of the table then we will use the Newton's backward interpolation formula.

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Question: What is meant precision and accuracy?

Answer: Precision and accuracy are two terms which are used in numerical calculations by precision we mean that how the values in different iterations agree to each other or how close are the different values in successive iterations. For example you have performed 3 different iterations and result of all the iterations are 1.32514, 1.32516, 1.32518 these three values are very precise as these values agree with each other. Accuracy means the closeness to the actual value. Suppose that you have calculated an answer after some iteration and the answer is 2.718245 and the actual answer is 2.718254 and the answer calculated is very accurate but if this answer is 2.72125 then it is not accurate.

Question: What is the condition that a root will lie in an interval.

Answer: Suppose that you have a function  $f(x)$  and an interval  $[a, b]$  and you calculate both  $f(a)$  and  $f(b)$  if  $f(a)f(b) < 0$  then there must exist a root for this function in this interval. In simple words  $f(a)$  and  $f(b)$  must have opposite signs.

---

Question: How the divided difference table is constructed?

Answer: 

x	y	First difference	Second difference	Third difference
1	0.2	$y_1 - y_0/x_1 - x_0 = s_1y_0$	$s_1y_1 - s_1y_0/x_2 - x_0 = s_2y_0$	$s_2y_2 - s_2y_1/x_3 - x_0 = s_3y_0$
2	0.69	$y_2 - y_1/x_2 - x_1 = s_1y_1$	$s_2y_2 - s_2y_1/x_4 - x_1 = s_3y_1$	$s_3y_3 - s_3y_2/x_4 - x_1 = s_2y_2$
3	0.985	$y_3 - y_2/x_3 - x_2 = s_2y_2$	$s_3y_3 - s_3y_2/x_4 - x_1 = s_2y_2$	$s_2y_2$
4	1.2365	$y_4 - y_3/x_4 - x_3 = s_3y_3$	$s_2y_2$	$s_3y_3$
5	2.3651	$y_4$	$s_3y_3$	$s_2y_2$

 This is the complete table showing the central differences. Here  $s$  stands for difference

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Question: What is Gauss-Seidel Method

Answer: It is also an iterative method and in this we also check either the system is diagonally dominant and, if so then we proceed on the same lines as in the Jacobi's method. The difference in both is when we calculate a value of any variable that is instantly replaced by the previous value. If we have initial values like  $x_1=0, x_2=0$  and  $x_3=0$  in the case of three variables in the first

iteration we will use all the three values to calculate  $x_1$  but to calculate the value of  $x_2$  we will use the recent value of  $x_1$  which is calculated in the first iteration.

---

Question: What is partial and full pivoting?

Answer: Partial and full pivoting, In gauss elimination method when you have any of diagonal element  $a_{ii}$  zero it means the solution does not exist to avoid this we change the equation so that a non zero pivot is achieved. Now you have an argument matrix in which the elements in the first column are 1,3,4 respectively here in case of partial pivoting we will replace first element with the last element it is done by replacing the first equation with last equation it is known as partial pivoting. In full pivoting we change rows and columns but that is not implemented manually it is used in computers.

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Question: How the initial vector is chosen in power method?

Answer: Choose the initial vector such that the largest element is unity. But no problem with this you will proceed with this vector as it is and will not change it. In the given question the initial vector is provided so you have to proceed with the given vector and will normalize this vector and normalizing this vector you will keep in mind that the greatest value should be unity. An eigenvector  $V$  is said to be normalized if the coordinate of largest magnitude is equal to unity. Actually this condition is for the normalization of the vectors when you have to normalize the vector you keep in mind that the largest entry in the vector must be 1 and so you take the largest element and divide the remaining values by the greatest value.

Question: what is the relationship between  $p=0$  and non zero  $p$  in interpolation.

Answer:  $f_p = f_0 + pDf_0 + \frac{1}{2}(p^2 - p)D^2f_0 + \frac{1}{6}(p^3 - 3p^2 + 2p)D^3f_0 + \frac{1}{24}(p^4 - 6p^3 + 11p^2 - 6p)D^4f_0 + \dots$  This is the interpolation formula. For the derivative you will have to take the derivative of this formula w.r.t  $p$  and you will get  $f'_p = \frac{1}{h} \{ Df_0 + \frac{1}{2}(2p-1)D^2f_0 + \frac{1}{6}(3p^2 - 6p + 2)D^3f_0 + \dots \}$ . Now put here  $p=0$   $f'_p = \frac{1}{h} \{ Df_0 + \frac{1}{2}(0-1)D^2f_0 + \frac{1}{6}(0-0+2)D^3f_0 + \dots \}$ . So the formula becomes  $f'_p = \frac{1}{h} \{ Df_0 + \frac{D^2f_0}{2} + \frac{D^3f_0}{3} + \dots \}$  so this is the relationship between non zero and zero  $p$  now when you have to calculate  $p$  you use formula  $p = \frac{x - x_0}{h}$  so this is the impact of  $x$ .

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Question: What is chopping and Rounding off?

Answer: Chopping and rounding are two different techniques used to truncate the terms needed according to your accuracy needs. In chopping you simply use the mentioned number of digits after the decimal and discard all the remaining terms. Explanation  $(\frac{1}{3} - \frac{3}{11}) + \frac{3}{20} = (0.333333\dots - 0.272727\dots) + 0.15 = (0.333 - 0.272) + 0.15$  This is the three digit chopping.

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Question: When the forward and backward interpolation formulae are used?

Answer: In interpolation if we have at the start then we use the forward difference formula and the formula to calculate  $p$  is  $\frac{x - x_0}{h}$ . If the value of  $x$  lies at the end then we use Newton's backward formula and formula to calculate the value of  $p$  is  $\frac{x - x_n}{h}$ . Now I come to your question as in this case the value lies at the end so  $x_n$  will be used as the  $x_n$ . This procedure has been followed by the teacher in the lectures. But some authors also use another technique that is if you calculate the value of  $p$  and that is negative then the origin is shifted to that value for which the value of  $p$  becomes positive. And then according to that origin the values of differences are used and you need not follow this procedure.

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Question: What is forward and backward difference operator and the construction of their table.

Answer: For forward  $Df_r = f_{r+1} - f_r$   $Df_0 = f_1 - f_0$  In terms of  $y$   $Dy_{r+1} = y_{r+1} - y_r$   $D$  stands for the forward difference operator. For backward  $Df_r = f_r - f_{r-1}$   $Df_1 = f_1 - f_0$  In terms of  $y$   $Dy_1 = y_1 - y_0$  Here  $D$  stands for backwards operator. Now the construction of the difference table is based on  $X$   $Y$  1st forward 2nd forward 3rd forward  $x_1$   $Y_1$   $Y_2 - Y_1 = Dy_0$   $x_2$   $Y_2$   $Y_3 - Y_2 = Dy_1$   $x_3$   $Y_3$   $Y_4 - Y_3 = Dy_2$   $x_4$   $Y_4$  Now consider the construction of table for the backward table  $X$   $Y$  1st forward 2nd forward 3rd forward  $x_1$   $Y_1$   $Y_2 - Y_1 = Dy_1$   $x_2$   $Y_2$   $Y_3 - Y_2 = Dy_2$   $x_3$   $Y_3$   $Y_4 - Y_3 = Dy_3$   $x_4$   $Y_4$  Dear student this is the main difference in the construction of the forward and backwards difference table when you proceed for forward difference table you get in first difference the value  $Dy_0$  but in the construction of backwards difference table in the first difference you get  $Dy_1$  and in the second difference in the forward difference table you get  $D^2 y_0$  and in the backward

difference table the first value in the second difference is  $D^2 y_1$ . I think so you have made it clear.

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Question: What is Jacobi's method?

Answer: Jacobi's Method It is an iterative method and in this method we first of all check either the system is diagonally dominant and, if the system is diagonally dominant then we will calculate the value of first variable from first equation in the form of other variables and from the second equation the value of second variable in the form of other variables and so on. We are provided with the initial approximations and these approximations are used in the first iteration to calculate first approximation of all the variables. The approximations calculated in the first iteration are used in the second iteration to calculate the second approximations and so on.

Question: what is Simpson's 3/8th rule.

Answer: The general formula for Simpson's 3/8th rule is  $\frac{3h}{8}[f_0+3(f_1+f_2)+2f_3+(3f_4+f_5)+2f_6+\dots+3(f_{n-2}+f_{n-1})+f_n]$  Now if we have to calculate the integral by using this rule then we can simply proceed just write first and last value and distribute all the remaining values with prefix 3 and 2 Like you have  $f_0, f_1, f_2, f_3, f_4$  Then the integral can be calculated as  $\frac{3h}{8}[f_0+f_4+3(f_1+f_2)+2f_3]$  If we have values like  $f_0, f_1, f_2, f_3, f_4, f_5$  Then integral can be calculated as  $\frac{3h}{8}[f_0+3(f_1+f_2)+2f_3+3f_4+f_5]$  Similarly proceeding in this fashion we can calculate the integral in this fashion

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Question: what is classic runge-kutta method

Answer: The fourth order Runge-Kutta method is known as the classic formula of classic Runge-Kutta method.  $y_{n+1}=y_n+\frac{1}{6}(k_1+2k_2+2k_3+k_4)$  Where  $k_1=hf(x_n, y_n)$   $k_2=hf(x_n+h/2, y_n+k_1/2)$   $k_3=hf(x_n+h/2, y_n+k_1/2)$   $k_4=hf(x_n+h, y_n+k_3)$

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Question: What is meant by TOL?

Answer: The TOL means the extent of accuracy which is needed for the solution. If you need the accuracy to two places of decimal then the TOL will be  $10^{-2}$ . Similarly the  $10^{-3}$  means that the accuracy needed to three places of decimal. Suppose you have the root from last iteration 0.8324516 and 0.8324525 if we subtract both and consider absolute value of the difference 0.0000009 now it can be written as  $0.09 \times 10^{-5}$  so the TOL in this case is  $10^{-5}$ . Similarly if we have been provided that you have to for the TOL  $10^{-2}$  you will check in the same way. In the given equation you will solve the equation by any method and will consider some specific TOL and try to go to that TOL. Some time no TOL is provided and you are asked to perform to some specific no of iterations.

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Question: what is meant by uniqueness of LU method.

Answer: An invertible (whose inverse exists) matrix can have LU factorization if and only if all its principal minors (the determinant of a smaller matrix in a matrix) are non zero. The factorization is unique if we require that the diagonal of L or U must have 1's. The matrix has a unique LDU factorization under these conditions. If the matrix is singular (inverse does not exist) then an LU factorization may still exist, a square matrix of rank (the rank of a matrix in a field is the maximal no of rows or column) k has an LU factorization if the first k principal minors are non zero. These are the conditions for the uniqueness of the LU decomposition.

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Question: how the value of h is calculated from equally spaced data.

Answer: Consider the following data x y 1 1.6543 2 1.6984 3 2.4546 4 2.9732 5 3.2564 6 3.8765 Here for  $h=2-1=3-2=1$  x y 0.1 1.6543 0.2 1.6984 0.3 2.4546 0.4 2.9732 0.5 3.2564 0.6 3.8765 Here for the calculation of  $h=0.2-0.1=0.3-0.2=0.1$  I think so that you may be able to understand.

# GLOSSARY

**(this is also important for the short questions and MCQS)**

**Absolute Error :** The absolute error is used to denote the actual value of a quantity less its rounded value if  $x$  and  $x^*$  are respectively the rounded and actual values of a quantity, then absolute error is defined by  $AE = |x - x^*|$

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**Accuracy :** The extent of the closeness between the actual value and estimated value is known as accuracy. Suppose you have taken readings like 2.1234, 2.1236 and 2.1238 and 2.45, 2.52, 2.63. Now if the actual root is 2.65 then the second values are more accurate and not precise but first set of values is precise but not accurate as it differs from the actual value.

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**Algebraic equation :** The equation  $f(x) = 0$  is known as algebraic equation if it is purely a polynomial in  $x$ . Like  $f(x) = 3$ ,  $f(x) = x^3 - 3x - 4$  are some examples of algebraic equations and if the variable is changed to  $y$  or any one then under the same conditions it will be algebraic.

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**Bisection method :** It is a bracketing method which is used to locate the root of an equation and it makes use of the intermediate value property to locate the interval in which the root lies, formula which is used is  $(a+b)/2$  where  $a$  and  $b$  are points such that  $f(a)f(b) < 0$ .

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**Bracketing Method :** The iterative methods which require two initial approximations for its first iteration are known as bracketing methods. Bisection method is the example of the bracketing method as it requires an interval for the approximation of the root.

**Crout's Method :** This method is used to solve the system of equations by decomposing the system into two matrices  $L$  and  $U$  where  $L$  is a lower triangular matrix and  $U$  is an upper triangular matrix. In  $U$  all the elements in the main diagonal are 1.

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**Descartes rule of signs :** The number of positive roots of an algebraic equation  $f(x) = 0$  with real coefficients cannot exceed the number of changes in the sign of the coefficients in the polynomial  $f(x) = 0$ , similarly the number of negative roots of  $f(x) = 0$  cannot exceed the number of changes in the sign of the coefficients of  $f(-x) = 0$ .

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**Direct methods :** These are the methods which do not need the knowledge of the initial approximation and are known as direct methods.

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**Gauss Elimination Method :** It is a direct method which is used to solve a system of equations.

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**Gauss seidel iterative method :** It is an iterative method in which an initial approximation is given. First of all the system should be checked either it is diagonally dominant or not. If it is not then it is made diagonally dominant. Secondly the first variable is calculated in terms of other variables from the first equation and the second variable from the second equation and so on. The previous value of the variable is replaced by the new value instantly as it is obtained. This is the difference between the Gauss-Seidel and Jacobi iterative methods.

**Graeffe's root squaring method :** This method is used to find all the roots of the polynomial equation.

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**Intermediate value property :** If for an equation  $f(x) = 0$  for two values  $a$  and  $b$  we have such that  $f(a)f(b) < 0$  then there must exist a root between  $a$  and  $b$  in the interval  $[a, b]$ .

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Inverse of a matrix :	The matrix B is said to be inverse of a matrix A if the product of and B is I identity matrix.
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Iterative methods :	Iterative methods are those type of methods which always require an initial approximation to start an iteration
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Jacobie's iterative method: :	It is an iterative method in which an initial approximation is given. First of all system should be checked either it is diagonally dominant or not if it is not then it is made diagonally dominant. Secondly the first variable is calculated in terms of other variables from first equation and Second variable from second equation and so on after first iteration in the second iteration all the variables are replaced by the previous one.
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Muller's Method :	In Muller's method $f(x)=0$ is approximated by a second degree polynomial, that is by quadratic equation that fits through three points in the vicinity of a root .Then roots of this quadratic equation are then approximated to the roots of equation $f(x)=0$
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Newton Raphson Method. :	It is an open method which is used to locate a root of the equation, it needs only one initial approximation for it's first iteration. $x_{n+1}=x_n-(f(x_n)/f'(x_n))$
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Non singular matrix :	A matrix is said to be non singular if the determinant of the matrix is non zero. $ A $ is not equal to zero and the inverse of non singular exists.
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Open methods :	The methods which require only one initial approximation to start the first iteration, for example the Newton's Raphsom method is known as the open method as it requires only one initial approximation.
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Pivoting :	If any of the pivot elements in gauss elimination become zero then this method fails so to Avoid such type of situation equation are rearranged to get rid of zero pivot element, this procedure is known as pivoting.
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recision :	The extent of closeness of different measurement taken to estimate a certain value. Suppose you have done different iterations to measure the root of an equation and take different values as 2.1234, 2.1236, and 2.1238 these all the values are very close to each other so these are very precise.
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Regula –Falsi method :	It is also an iterative method and is a bracketing method and use intermediate value property to get it's initial guess. The formula used for this is $x_{n+1}=x_n-(x_n-x_{n-1}/f(x_n)-f(x_{n-1}))$
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Relative Error :	It is the ratio of the absolute error to the actual value of the quantity. Thus $RE=AE=AE/ x^* $
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Relaxation method :	It is also an iterative method and in this method you solve the system of equation by making the greatest residual to zero.
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Root :	If you have an equation $f(x)=0$ then the no a is said to be the root of the equation if $f(a)=0$ Suppose you have an equation $f(x)=x^2-4$ the 2 is a root of the equation as $f(2)=4-4=0$
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Secant Method :	The secant method is also an open method and it takes two initial values for it's first approximation, the formula used for this is known as $x_{n+1}=\{x_n-1f(x_n)-x_n f(x_{n-1})\}/\{f(x_n)-f(x_{n-1})\}$
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Significant digits :	A significant digit in an approximate no is a digit, which gives reliable information about the size of the number. In other words a significant digit is used to express accuracy, that Is how
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many digits in the no have meaning.

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Singular matrix : A matrix is said to be a singular matrix if the determinant of the matrix is zero  $|A|=0$ , the inverse of the singular matrix do not exist.

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Transcendental equation : An equation  $f(x) = 0$  is said to be transcendental equation if it contains trigonometric, logarithmic and exponential functions

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Truncation Error : It is defined as the replacement of one series by another series with fewer terms. The error arising by this approximation is known as truncation error.

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