**NUMERICAL METHODS**

**POLYNOMIAL:** A function is of the form and are the constants is called degree polynomial. Where n is Positive integer.

**POLYNOMIAL EQUATION:** If is polynomial, then is called polynomial equation.

Degree polynomial equation has ‘n’ roots.

**ALGEBRAIC FUNCTION:** A function obtained by applying finite number of algebraic operations on polynomials is called Algebraic function. All Polynomial functions are algebraic functions.

**ALGEBRAIC EQUATION:** If is Algebraic function, then then is called Algebraic Equation.

Every polynomial equation is algebraic equation but converse need not be true.

**TRANSCENDENTAL EQUATION:** An equation other than Algebraic equation is called transcendental equation.

Transcendental equation may have no root or finite number of roots or infinite roots.

**DESCARTES' RULE OF SIGN:** If is polynomial, then

* No. of Positive real roots of No. of changes of signs in
* No. of Negative real roots of No. of changes of signs in

|  |  |  |
| --- | --- | --- |
| **No. of Roots** | | |
| **Real Roots** | | **Complex Roots** |
| **+ ve** | **- ve** |  |

**REAL ROOTS OF AN EQUATION:** If is a real root of an equation , then the curve intersects real axis at .

**INTERMEDIATE VALUE THEOREM:** If is continuous on and if have opposite signs, then at least one real root lies between .

**ERRORS OF APPROXIMATION:**

**ABSOLUTE ERROR:**

**RELATIVE ERROR:**

**PERCENTAGE ERROR:**

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Here, If is large, convergence is fast. And If is small, convergence is slow.

If , the convergence is called Liner convergence.

If , the convergence is called Quadratic convergence.

If , the convergence is called Cubic convergence.

**TRUCATED ERROR:** The error obtained by truncations of the infinite sum to approximate it to finite sum is called traction error.

**BISECTION METHOD:**

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| If has a real root in ,  **1st Approximation:**  If , is root, Else  CASE-I: If have opposite signs root lies between and  CASE-II: If have opposite signs root lies between and  **2nd Approximation:** | **Advantages and Disadvantages:**   * Convergence is guaranteed. * Method never fails. * Convergence is very slow. * Order of Convergence * Nth Stage Interval length = * **Permissible error** |

**REGULA-FALSI METHOD (METHOD OF FALSE POSITION):**

|  |  |
| --- | --- |
| If has a real root in ,  If , is root, Else  CASE-I: If have opposite signs root lies between and  CASE-II: If have opposite signs root lies between and | **2nd Approximation:** |

**Advantages and Disadvantages:** Convergence is very slow And Order of Convergence .

**NEWTON’S RAPHSON METHOD (METHOD OF TANGENT):**

If has a real root in , (n+1)th iteration with initial guess .

|  |  |
| --- | --- |
| **Advantages and Disadvantages:**   * The method converges fast. Eg. if choose nearest to the roots, convergence is fast otherwise it’s slow or sometimes it diverges also. * Order of Convergence . * It improves the results of previous methods. | **NOTE:**  If , in the neighbour hood of then this method fails. |

**SECANT METHOD:**

If has a real root in and initial guess ,

**Advantages and Disadvantages:** Order of Convergence (Super Liner Convergence).

**INTERPOLATION AND CURVE FITTING:**

**LAGRANGE’S INTERPOLATION:**

**NEWTONS DIVIDED DIFFERENCE INTERPOLATION:**

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**NEWTONS FORMULA OF INTERPOLATION FOR EQUALLY SPACED POINTS:**

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**Newtons Forward Difference Formula:**

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| --- | --- |
|  |  |

**Newtons Backward Difference Formula:**

|  |  |
| --- | --- |
|  |  |

Where, h = Length of each equal sized sub-interval.

**CURVE FITTING (FITTING OF STRAIGHT LINE):**

|  |  |
| --- | --- |
| **and find by solving 2 Equations.** |  |
|  |

Where, n = Number of points.

**NUMERICAL INTEGRATION:**

Using Newton’s Forward interpolation **Newton and Cote** Derived Quadrature formula.

**NEWTONS TRAPEZOIDAL RULE:** n = 1 in Newton’s Cote Quadrature formula.

**SIMPSON’S RULE:** n = 2 in Newton’s Cote Quadrature formula.

**NUMERICAL DIFFERENTIATION:**

If and initial condition , then

**TAYLOR SERIES METHOD:**

**RANGE-KUTTA METHOD:**

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| --- | --- | --- |
| **Euler’s Method (1st Order R-K Method):** | | |
|  | |  |
| **Modified Euler’s Method (2nd Order R-K Method):** | | |
|  |  |  |
| **3rd Order R-K Method:** | | |
|  |  |  |
| **4rd Order R-K Method:** | | |
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