**Method of Solving Homogeneous Equations with Constant Coefficients;**

The linear homogeneous diff. eq. with form ;

….(1)

Where the coefficients  **;(*j***=0,1,2,…,n-1) are constants .

Formed by differential operators as;

Then eq.

…..(2)

for n th-order written as **;**

And for second order as;

….(3)

is the **characteristic equation** for eq. (1) ,which is obtained by replacing by ,respectively .**Which only for linear homogenous diff. eqs. with constant coefficients**

This eq. can be factored into ;

**The General Solution;**

The roots of the characteristic equation determine the solution of linear homogeneous diff. eq. ,here will study solution for **high order homogeneous linear diff. eq. with constant coefficients** in general form ,the second order as ;

…..(4)

Where are constants .

Solve eq.(4) by reduction into first order put the two values of are ;

Formed by differential operators as;

put

then  **,** so

the integration factor **,**

and the solution is;

substitute the solution then get on ;

the integration factorfor this equation is **,** and its solution is the solution for eq. (4) as;

…..(5)

**Then there are three possibilities for roots;**

**Case 1; if**   **real numbers** then eq.(3) is equivalent to

And the the eq. (4) be;

Solved by reduction of order ,the solution will be as;

Since is an arbitrary constant ,is also an arbitrary constant and therefore the solution can be written as ;

if

In a special case when  the solution can written as;

**Case 2; if**   **real numbers** then the solution will is equivalent to ;

**Case 3; if**   **are complex numbers** , since are real ,then the roots of eq.(3) are appears as conjugate pair as;  .

Then the two linearly independent solutions are ;

Which algebraically equivalent to ;

Where

Example 1; Solve the equation ;

Thecharacteristicequation is

Thus the roots are ; 2

The first root is distinct so ,the other roots are equaled then ,then the complete solution is given by ;

Example 2; Solve the equation;

Thecharacteristicequation is

So the solution is

Example 3; Solve the equation ;

Thecharacteristicequation is

Thus the roots are ;

The first root is distinct so ,as a part of solution ,the other roots are complex then

,then the complete solution is given by ;

**Exercises** : Solve the following equations ?

1. **sol;**
2. **sol;**
3. **sol;**
4. **sol;**
5. **sol;**
6. **sol;**