**SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS**

Let y be the dependent variable and x be the independent variable.

In theory, a second order differential equation should have two solutions.

**3.2 The general form of the second order linear differential** equation is given as:

**3.3 STANDARD FORM**

Dividing by a(x)

This can then be reduced to the standard form

**3.4 HOMOGENEOUS AND NON-HOMOGENEOUS DE**

Given the standard form of a second-order linear differential equation: ,

The above is said to be homogeneous if . If and it is a function of x, then it is non-homogeneous

**3.5 SUPERPOSITION THEOREM**

This theorem is going to be used a lot especially when solving questions relating to non-homogeneous differential equations.

If  and are two solutions of the homogeneous equation

, then

is also a solution for any and

**3.5.1 PROOF**

Define (This is a linear operator)

and are solutions.

The operator is linear because it meets the requirement of linearity: That is

1.

2.

Then considering

Therefore, y is also a solution.

You see this side above of linearity and shit, when I wrote it initially it was God and I that understood what the fuck that was; but rn that I am reviewing it, only God understands oh.

**3.6 LINEAR INDEPENDENCE**

**3.6.1 DEFINITION**

If for any value of x i.e. if the equation on the left actually equals zero, then this implies that , we say that and are **linear independent**. If the functions are not linearly independent, they are linearly dependent

Show that

and

Answer: Suppose for any x.

Substitute, x=0,

This implies that

Now, let ,

Thus, .

Therefore by the definition and are linearly independent.

**3.6.2 TEST FOR LINEAR INDEPENDENCE**

**3.6.2.1 WROSKIAN TEST FOR LINEAR INDEPENDENCE**

For some , then and are linearly independent.

Example

Show that and are linearly independent

Since the answer for any x, then and are linearly independent

Note: The following sets and their subsets are linearly independent

1.

2.

3.

4.

5.

6.

7.

8.

Theorem to note:

If and are two linearly independent solutions of the homogeneous equation

The general solution is given by

and are constants

Shit!!!! WTF did I write here. I’m so clueless

Theorem: Existence and Uniqueness theorem:

If p,q and f are continuous on the on some interval containing a, then , has a unique solution satisfying

and