GEG 219 (Ordinary Differential Equations) 2units

1. Introduction to Differential Equations

- Linear dependence

- Classification of Ordinary Differential Equations

\* Order

\* Degree

\* Linearity.

2. First Order ODEs

- Types and Techniques of solution of first order ODE’s

- Picard’s iterative method

- physical applications of first order ODE.

3. Theory and solutions of higher order linear equations; physical applications.

4. Ordinary differential equations with constant coefficients

- Methods of undetermined coefficients

-Variation of parameters

- D-Operator.

5. Linear Differential Equations with Variable coefficients.

6. Cauchy-Euler’s equations

7. Systems of linear operations

8. Properties of linear operations

9. Series solution

8. First order non-linear equations

- Autonomous

- Equidimensional

- Scale-invariant

INTRODUCTION TO DIFFERENTIAL EQUATIONS

A differential equation is one which contains a function and its derivative in the same equation.

A differential equation is a relationship between an independent variable x, a dependent variable y and at least one derivative y

NB:

TYPES OF DIFFERENTIAL EQUATIONS

1. Ordinary Differential Equations: This is one in which the unknown function (y) depends only on one independent variable (x).

2. Partial Differential Equations. This is one in which the unknown functions depends on at least two independent variables.

FORMATION OF A DIFFERENTIAL EQUATION

A differential equation is formed when arbitrary constants are eliminated from a given function.

ORDER AND DEGREE OF A DIFFERENTIAL EQUATION

The order of a DE is the highest derivative appearing in the equation. It is also called differential coefficient.

The degree of a DE is the power of the highest order is the degree

a. . This will have an order of 2 and a degreee of 1.

The order of a differential equation indicates how many initial conditions are needed to find a unique solution.

INITIAL VALUE PROBLEM AND BOUNDARY VALUE PROBLEM

In initial value problem, we are given the value of the function y(x) and its derivative y’(x) at the same point (initial point)

and

Boundary Value Problems: Here we are given the value of function y(x) at two different points i.e. ,

LINEAR AND NON-LINEAR DIFFERENTIAL EQUATIONS

A linear differential equation is one where the degree is 1.

CONDITIONS FOR LINEAR DIFFERENTIAL EQUATION

1. In front of y and its derivatives must only be pure functions of x and never of y or other variables.

2. The powers of y and its derivatives must be 1. (Degree of 1)

3. g(x) must also be a function of x and neither y or its derivative should be there.

LINEAR DEPENDENCE

Linear Dependence is used as a method of solution for 2nd Order Ordinary Differential Equations (ODE)

Given two non-zero functions and defined in the equation below

(1)

Notice that and will make equation (1) to be true for all values of regardless of the functions that we use.

Now, if we can find non-zero values of and ( and ) for which equation (1) will still be true i.e. (eqn. (1)) for all values of , then we call the two functions ( and ) linearly dependent functions.

On the other hand, if the only two constants for which eqn.(1) is true are and , then we call the functions linearly independent functions.

How to determine whether functions are Linearly Dependent or not (Linearly Independent)

Wroskian Method

Let and be differentiable functions and and be differentials of and then they are Linearly Dependent if the non-constants and with

Or